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(54) Title: A SUTURE ANCHOR			
(57) Abstract			
<p>One embodiment of the instant invention is made up of a guide wire component (13), a proximal wedge component (14) and a distal wedge component (15). In a second preferred embodiment, a uniquely designed surgical wedge anchor is provided having a barbed top portion (105), a plurality of suture holes (101, 102, 101b, 102b, 103, 103b) and a centrally located lower tooth (106) within a rounded notch in a lower-most portion (122).</p>			

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A SUTURE ANCHORBackground of the InventionField of the Invention

The instant invention relates to that panoply of devices that serve to anchor to bone, or soft tissue, suture materials for the purpose of facilitating adherence of soft tissues such as muscle and ligament tissues in close apposition to such bone by way of such suture materials being sewn thereto and therein.

Brief Description of Related Prior Art

The following patents may bear somewhat on the essence of the instant invention. However, the instant invention represents a manifest improvement upon and variation from any other arguable similar devices current in or out of vogue within the scope of the field of such devices.

<u>Inventor(s)</u>	<u>Title Invention</u>	<u>U.S. Patent No.</u>	<u>Issue Date</u>
Goble et al	Harpoon Suture Anchor	5,141,520	8/25/92
Gatturna et al	Suture Anchor	4,898,156	2/6/90
Chow	Surgical Implement	5,176,682	1/5/93
Anspach, Jr.	Suture Anchor and Method of Forming	5,102,421	4/7/92
Fischer et al	Bone Fastener	4,716,893	1/5/88
Goble et al	Ligament Anchor System	4,870,957	10/3/89
Hayhurst et al	Bone Anchor and Method of Anchoring a Suture to a Bone	5,037,422	8/6/91

There are numerous and various types of anchor devices in existence today that are designed to facilitate the

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1 holding of soft tissue to bone by way of holding surgical  
2 sutures sewn into such soft tissue. But, these devices and  
3 means such as screws with loops on their crowns, glues and  
4 the like are universally amenable to failure over time due  
5 to, for example, degradation of bone, breakage at joints  
6 within such devices or adhesive defects. Such failure  
7 requires readmission of affected patients to surgery and  
8 subjugation of such persons to inherent risks and  
9 inexorable expense related to the same. Hence, the  
10 essential object of the instant invention is to obviate, to  
11 the fullest possible extent, such failure.

12 The instant invention has no relatively delicate joint  
13 sites. One embodiment functions by way of action-reaction  
14 laterally directed and hence once wedged into place simply  
15 cannot come loose under the influence of whatever  
16 physiological load force as could conceivably be applied to  
17 it. Another embodiment functions by way of toggle movement  
18 laterally directed and hence once lodged into place cannot  
19 come loose under physiological force load.

20 The instant invention is, respectfully submitted, in  
21 view of the foregoing, new, indeed revolutionary within its  
22 field and unquestionably useful and unique in that it  
23 functions in a truly new and unique way as a viable anchor.  
24 Moreover, in view of its new and unique type of framework,  
25 its dependability from a standpoint of essentially non-  
26 susceptibility to breakage in situ is beyond reproach.

27 Also, the second embodiment of the instant invention  
28 constitutes a significant improvement, over the suture  
29 anchor of the first embodiment since, the relative  
30 complexity of and cost of manufacture of the proximal wedge  
31 component thereof exceed not insignificantly the same as  
32 respects any of the above-mentioned distal wedge  
33 embodiments. Moreover, the barbed tip and lower tooth  
34 features of the above-mentioned embodiment facilitates even  
35 more effective embedding into tissue material especially  
36 bone than does the beveled top edge of the distal wedge

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1 component of the suture anchor especially absent the  
2 presence of that device's proximal wedge component.

3 Finally, the device of this second embodiment is  
4 likewise essentially non-breakable, and, for all of the  
5 foregoing reasons, respectfully stated, constitutes a new,  
6 useful, and unique advancement in the art relating to  
7 devices of this nature.

8 Summary of the Invention

9 One preferred embodiment of the instant invention is  
10 made up of three essential components. One is a so-called  
11 distal wedge. A second is a so-called proximal wedge.  
12 And, the third is a guide wire to which the first two  
13 components are fastened but amenable to removal therefrom.

14 A surgeon utilizes this embodiment of the instant  
15 invention by first resorting to utilization of a cannulated  
16 drill bit and drilled a hole into bone. Then the surgeon  
17 inserts the guide wire component of the instant invention  
18 through the lumen of the embedded drill bit after having  
19 first removed the drill therefrom by loosening the drill  
20 chuck and pulling the drill away. Once the guide wire is  
21 within the lumen of the bit, then the drill bit is removed  
22 by holding the guide wire with one hand and pulling out the  
23 bit with the other by way of a pincer device after having  
24 first removed the proximal wedge and distal wedge  
25 components from the guide wire component. Then the hand  
26 holding the guide wire above the removed bit is placed  
27 below the bit to continue holding the wire in place in the  
28 drilled hole while the bit is pulled up and off the wire.  
29 Then the wedge components are placed back on the guide wire  
30 after first threading suture wire through the distal wedge  
31 component and the wedge components are guided down the  
32 guide wire in the drilled hole and tamped down into place  
33 within the drilled hole. An insertion tool is utilized for  
34 such purpose. Then the guide wire component is removed  
35 from the drilled hole. Once the wedge components of the  
36 invention are in place, then downward pressure is applied

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1 to the head of the proximal wedge component by pushing down  
2 on it with the insertion tool to push it into the drilled  
3 hole while upward pressure is applied to the suture thread  
4 previously threaded through and about the base of the  
5 distal wedge. This combination of pushing and pulling  
6 causes the distal wedge to slide upwards against the  
7 proximal wedge being pushed downward. This action of  
8 sliding upward causes the inclined medial faces of each  
9 wedge component to slide over one another and to  
10 concomitantly push each wedge component laterally out  
11 against the sides of the drilled hole. The wedge  
12 components are thus pressed firmly and permanently into  
13 place by virtue of the increase in the central diameter of  
14 the two wedge components in interfaced apposition to one  
15 another in situ after application of the combined pressures  
16 of pushing down from the top and pulling up on the sutures  
17 about the bottom of the combined wedges. The lateral  
18 portion of the proximal wedge in situ is made up of a set  
19 of serrated edges that bite into the bony side of the hole  
20 in apposition to it. The top portion of the body of the  
21 distal wedge is beveled so as to dig into the bony side of  
22 the hole in apposition to it. The medial portion of the  
23 proximal wedge in situ has two suture grooves to  
24 accommodate suture material threaded through two  
25 cylindrical holes in the medial portion of the distal wedge  
26 in situ. Suture material is threaded through one of these  
27 two cylindrical holes and out through a circular hole in  
28 the base of the distal wedge and then through a second  
29 circular hole in the base of the distal wedge and up  
30 through the body of the distal wedge and out the other of  
31 these two cylindrical holes. The base of the distal wedge  
32 component in the vicinity of the two holes in the base is  
33 inclined so as to prevent contact between suture thread  
34 passing from one circular hole to the other and the guide  
35 wire emanating from a third hole in the base. The proximal  
36 wedge has a round hole through its head and through its

1 body running lengthwise that terminates in the inclined  
2 medial face in the lower portion of its body. This hole is  
3 the hole through which the guide wire component is  
4 initially threaded. The medial portion of the distal wedge  
5 in situ has as well a hole in it, below the above-described  
6 two cylindrical suture holes, for receipt of the guide wire  
7 component that exits through the third hole in the base of  
8 the distal wedge.

9 The proximal wedge also has a stop face running out at  
10 a slightly obtuse angle from the angulation of its inclined  
11 medial face. The stop face by ultimately interfacing with  
12 a medially located distal wedge stop face prevents the  
13 distal wedge from sliding by the proximal wedge and thereby  
14 defeating the intended action of the two wedge components  
15 of the invention, to wit, permanent anchoring within a hole  
16 drilled in bone when upward pressure is applied to the  
17 suture thread by pulling the two ends of the thread upwards  
18 as downward pressure is applied to the head of the proximal  
19 wedge after the tamping down of the two wedges into the  
20 drilled hole. Upward pulling causes the stop face located  
21 on the medial aspect of the distal wedge to interface with  
22 the stop face of the proximal wedge to thereby prevent the  
23 distal wedge from sliding too far by the proximal wedge in  
24 situ and thereby preventing the desired anchoring within  
25 bone.

26 Another embodiment of the instant invention includes a  
27 uniquely designed surgical wedge anchor that differs  
28 markedly from any other device of a similar nature that has  
29 heretofore been known. The wedge in this preferred  
30 embodiment has a barbed top portion, three smooth surfaced  
31 sides, two suture holes in the somewhat inclined upper  
32 portion of the remaining one of its sides that is not  
33 smooth surfaced, two laterally positioned suture holes in  
34 its base each one connected to one of the two suture holes  
35 in the upper portion of its non smooth surfaced side, a  
36 first centered hole in the middle of the upper portion of

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1 the non-smooth surfaced side which first centered hole is  
2 between and below these two suture holes, a centered hole  
3 in its base connected to the first described center hole,  
4 an inclination in its base so as to minimize drift of  
5 suture thread passing from the two lateral holes in the  
6 base to the centered hole in the base and ultimately  
7 passing through the first centered hole, and finally, a  
8 stop face that angulates outwardly from the plane of the  
9 upper portion of the wedge's non-smooth surfaced side in  
10 which the above described holes are found and that serves  
11 to separate that side's upper portion from its lower  
12 portion inclined in an plane of inclination with direction  
13 of inclination similar to the direction of inclination of  
14 the plane of inclination of this side's upper portion. The  
15 stop face also serves to interface with the inclination in  
16 the base of a second wedge when two wedges are utilized for  
17 anchoring purposes so as to prevent slippage of one over  
18 the other during the end of the anchoring process. The  
19 wedge anchor in a third and preferred embodiment reflects  
20 all of the features of the second embodiment except that  
21 additionally it has a centrally positioned barbed tooth  
22 located in an area cut out of the lowest segment of the  
23 lower portion of the wedge's non-smooth surfaced side. The  
24 wedge anchor in a fourth embodiment resembles the third  
25 embodiment but lacks any paired suture holes in either the  
26 upper portion of its non-smooth surfaced side or in the  
27 inclined portion of the wedge's base. Finally, a fifth  
28 embodiment resembles the fourth embodiment but lacks the  
29 tooth found in the fourth embodiment. A sixth embodiment  
30 wherein there is no inclination in the base of the anchor  
31 wedge is yet another useful variant. A seventh embodiment  
32 is one that resembles any of the above described  
33 embodiments but lacks a stop face. In fact, the above  
34 described preferred embodiment without a stop face is an  
35 ideal variant for purposes of serving alone as a wedge  
36 anchor. One or more of the above described wedges can be  
37 utilized to anchor soft tissue to bone by way of suture



1 threading during surgery or soft tissue to soft tissue by  
2 way of a suture threading during surgery. Soft tissue  
3 connotes either muscle or cartilage or ligaments, for  
4 example.

5 A preferred method of using the second embodiment will  
6 now be described. A hole is drilled into bone. Then a  
7 hollow insertion tool the base of which is cut at a bias  
8 with an outer circumference less than that of the drilled  
9 hole within which there is found a hollow plunger the base  
10 of which is cut at a bias with outer circumference less in  
11 measure than that of the perimeter of the lower portion of  
12 any embodiment but greater in measurement than the inner  
13 circumference of the insertion tool or the circumference of  
14 suture thread to be utilized, is resorted to for purposes  
15 of introducing one of the preferred embodiments or a  
16 plurality of these or one of these in combination with one  
17 or more of the other embodiments into the hole to serve as  
18 a suture anchor to which soft tissue can be sutured firmly  
19 in apposition to such bone. For example, suture thread is  
20 passed through the centered holes in the one or more of the  
21 latter two embodiments as might be utilized. A knot in the  
22 suture thread is tied just below the centered hole in the  
23 base of the bottom one of the embodiments to be so  
24 utilized. Then the suture material is threaded through the  
25 hollow plunger and the plunger together with threaded  
26 embodiments are encased within the hollow insertion tool.  
27 Then the system is introduced into the hole. Downward  
28 pressure is applied to the plunger and this pressure causes  
29 the embodiment or embodiments to be so used to be  
30 introduced under pressure into the hole in such bone as the  
31 insertion tool is simultaneously withdrawn from the hole  
32 then, continued downward pressure applied to the plunger  
33 coupled with upward pressure on the suture thread causes  
34 the wedges to toggle in apposition to one another thus  
35 creating an anchor. The barbed tip(s) dig into bone on one  
36 side of the hole. The lower tooth (teeth if a plurality of

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1   embodiments some of which are fourth embodiment variants  
2   are used) gouge into the other side of the hole by virtue  
3   of such applied downward pressure. One toggle wedge, to  
4   wit, the preferred embodiment also can be used if not so  
5   powerful a suture support is desired. Prior to use of this  
6   embodiment and insertion via the method described above,  
7   suture thread is run down each of the two upper portion  
8   suture holes so that a bridge runs from one hole to the  
9   other. Strands exiting suture holes, one per hole in the  
10  base are run up the centered hole in the base and out the  
11  first centered hole. These exiting strands are then run  
12  under the thread bridge up and away from the wedge. A  
13  plurality of wedges can be used to enhance the sturdiness  
14  of the suture support depending upon the particular  
15  requirements of the surgical procedure being resorted to.  
16  If it is desired to suture soft tissue to soft tissue,  
17  then, it would not be necessary to preliminarily drill a  
18  hole. The system can be initially prepared as noted above  
19  and the insertion tool containing within it, the one or  
20  more embodiments tied to suture material and plunger can be  
21  introduced into the soft tissue by way of merely piercing  
22  the tissue. The shape of the embodiments, the manner of  
23  suturing, and if a plurality are used for anchoring, then  
24  the base inclination and stop face characteristic all cause  
25  anchoring by toggling as previously noted, upward pressure  
26  is applied to suture thread along with downward pressure on  
27  a plunger.

#### 28   Brief Description of the Drawings

29       Figure 1 shows the three components of the first  
30   embodiment of instant invention, the proximal wedge  
31   component, the distal wedge component and the guide wire  
32   component in a perspective view.

33       Figure 2 is a frontal view of the proximal wedge  
34   component shown in Figure 1 that is indistinguishable from  
35   what would be a posterior view of this component.

36       Figure 3 is a view of the medial side of the proximal

1 wedge component shown in Figure 1, in respect of its  
2 positioning in situ within a hole drilled in bone.

3 Figure 4 is a view of the lateral side of the proximal  
4 wedge component of shown in Figure 1 in respect of its  
5 positioning in situ within a hole drilled in bone.

6 Figure 5 is a longitudinal cross-sectional view of the  
7 proximal wedge component shown in Figure 1.

8 Figure 6 is a top view of the proximal wedge component  
9 of shown in Figure 1.

10 Figure 7 is a perspective view of the proximal wedge  
11 component shown in Figure 1.

12 Figure 8 is a view of the medial side of the distal  
13 wedge component shown in Figure 1 in respect of its  
14 positioning in situ within a hole drilled in bone.

15 Figure 9 is a frontal view of the distal wedge  
16 component shown in Figure 1 that is indistinguishable from  
17 what would be a posterior view of this component.

18 Figure 10 is a view of the lateral side of the distal  
19 wedge component shown in Figure 1 in respect of its  
20 positioning in situ within a hole drilled in bone.

21 Figure 11 is a cross-sectional cut away view showing  
22 the beveled edge of the top side of the distal wedge  
23 component shown in Figure 1.

24 Figure 12 is a bottom view of the distal wedge  
25 component shown in Figure 1.

26 Figure 13 is a longitudinal cross-sectional view of the  
27 distal wedge shown in Figure 1.

28 Figure 14 is a perspective view of the medial side of  
29 the distal wedge component shown in Figure 1.

30 Figure 15 shows a cannulated drill bit about to be  
31 drilled into bone.

32 Figure 16 shows a cannulated drill bit removed from  
33 bone after a hole has been drilled into the bone and the  
34 guide wire component of the embodiment of Figure 1 inserted  
35 through the bit into the hole.

36 Figure 17 shows the guide wire component of the

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1 embodiment of Figure 1 drawn through the proximal wedge  
2 component of the instant invention.

3 Figure 18 shows suture thread through holes in the  
4 medial face and bottom of the distal wedge component shown  
5 in Figure 1.

6 Figure 19 is a longitudinal cross-sectional view of the  
7 proximal and distal wedge components of the embodiment of  
8 Figure 1 through which its guide wire component and suture  
9 threads have been threaded.

10 Figure 20 is a perspective view of the proximal wedge  
11 component of the embodiment of Figure 1 in apposition to a  
12 cut away view of the distal wedge component of said  
13 embodiment showing its guide wire component and suture  
14 threaded through the same.

15 Figure 21a is a perspective view of an insertion tool,  
16 to wit, a jaw within a sleeve.

17 Figure 21b is a perspective view of an insertion tool,  
18 to wit a jaw within a sleeve with the sleeve retracted to  
19 permit opening of the jaw closed only under the pressure of  
20 an overlapping non-retracted sleeve.

21 Figure 22 is a view of the whole embodiment of Figure 1  
22 and suture thread in the presence of an insertion tool with  
23 retracted sleeve.

24 Figure 23 is a view of the whole embodiment of Figure 1  
25 and suture thread in the presence of an insertion tool with  
26 non-retracted sleeve.

27 Figure 24 is a perspective view of the whole embodiment  
28 of Figure 1 and suture thread in the presence of an  
29 insertion tool with non-retracted sleeve.

30 Figure 25 shows the whole embodiment of Figure 2 being  
31 inserted into a hole drilled in bone shown in cross-  
32 sectional view after removal of the drill bit and insertion  
33 of its guide wire component.

34 Figure 26 shows the whole embodiment of Figure 1  
35 inserted into a hole drilled in bone shown in cross-  
36 sectional view subsequent to withdrawal of its guide wire

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1 component.

2 Figure 27 shows a dotted facsimile of a surgeons's left  
3 index finger and thumb holding the insertion tool and  
4 pushing down on the embodiment of Figure 1 within a hole in  
5 bone shown in cross-sectional view and a dotted facsimile  
6 of the surgeon's right index finger and thumb pulling up on  
7 suture thread.

8 Figure 28 shows a dotted facsimile of a surgeon's left  
9 index finger and thumb holding the insertion tool and  
10 pushing down on the embodiment of Figure 1 within a hole in  
11 bone shown in cross-setional view and a dotted facsimile of  
12 the surgeon's right index finger and thumb continuing to  
13 pull up on suture thread thereby causing the distal wedge  
14 component of the said embodiment in situ to rise against  
15 the proximal wedge component thereof.

16 Figure 29 shows the wedge components of the embodiment  
17 of Figure 1 firmly in-situ within a hole drilled into bone  
18 subsequent to retraction of the insertion tool.

19 Figure 30 is an enlarged view of the wedge components  
20 of the embodiment of Figure 1 shown firmly in-situ within a  
21 hole drilled into bone with arrows illustrating force  
22 vectors outwardly and laterally directed to the sides of  
23 the hole.

24 Figure 31 a reduced view of Figure 29 without arrows  
25 showing suture thread tied to soft tissue to be held in  
26 apposition to the bone.

27 Figure 32 is a plan view of the non-smooth surfaced  
28 side of a second embodiment of the instant invention.

29 Figure 33 is a plan view of the top portion of the  
30 embodiment of Figure 32.

31 Figure 34 is a plan view of the smooth front side of  
32 the embodiment of Figure 32.

33 Figure 35 is a plan view of the smooth side of the  
34 embodiment of Figure 32, opposite to the side of the same  
35 shown in Fig. 32.

36 Figure 36 is a longitudinal cross-sectional view of the

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1 embodiment shown in Figure 32.

2 Figure 37 is a plan view of the base of the second  
3 embodiment of the instant invention.

4 Figure 38 is a perspective view of the first embodiment  
5 of the second embodiment of the instant invention.

6 Figure 39 is a plan view of the non-smooth surfaced  
7 side of a third embodiment of the instant invention.

8 Figure 40 is a plan view of the top portion of the  
9 third embodiment of the instant invention.

10 Figure 41 is a plan view of the smooth front side of  
11 the third embodiment of the instant invention.

12 Figure 42 is a plan view of the smooth side of the  
13 third embodiment of the instant invention opposite the side  
14 of the same shown in Figure 39.

15 Figure 43 is a longitudinal cross sectional view of the  
16 third embodiment of the instant invention.

17 Figure 44 is a plan view of the base of the third  
18 embodiment of the instant invention.

19 Figure 45 is a perspective view of the third embodiment  
20 of the instant invention.

21 Figure 46 is a plan view of the non-smooth surfaced  
22 side of a fourth embodiment of the instant invention.

23 Figure 47 is a plan view of the top portion of the  
24 fourth embodiment of the instant invention.

25 Figure 48 is a plan view of the smooth front side of  
26 the fourth embodiment of the instant invention.

27 Figure 49 is a plan view of the smooth side of the  
28 fourth embodiment of the instant invention opposite the  
29 side of the same shown in Fig. 46.

30 Figure 50 is a longitudinal cross-sectional view of the  
31 fourth embodiment of the instant invention.

32 Figure 51 is a plan view of the base of the fourth  
33 embodiment of the instant invention.

34 Figure 52 is a perspective view of the fourth  
35 embodiment of the instant invention.

36 Figure 53 is a perspective view of an insertion device

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1 and plunger device located within the insertion device.

2 Figure 54 is a cross-sectional view of an insertion  
3 device and plunger device located within the insertion  
4 device.

5 Figure 55 is a cross-sectional view of the fourth and  
6 fifth embodiments of the instant invention held by a piece  
7 of suture thread.

8 Figure 56 is a plan view of what is seen in Fig. 55 in  
9 apposition to a plunger device and in apposition to an  
10 insertion device shown in cross-sectional view.

11 Figure 57 is a plan view of the fourth and fifth  
12 embodiments of the instant invention held by suture thread  
13 in close apposition to a plunger device shown cross-  
14 sectionally within the lumen of an insertion device shown  
15 in cross-sectional view.

16 Figure 58 shows an insertion device prior to its  
17 piercing a piece of soft tissue. There is also shown,  
18 suture material through the top of a plunger device shown  
19 within the insertion device.

20 Figure 59 shows an insertion device having pierced a  
21 piece of soft tissue. There is also shown, suture material  
22 through the top of a plunger device shown within the  
23 insertion device.

24 Figure 60 is an enlarged plan view of the third and  
25 fourth embodiments of the instant invention held by suture  
26 thread in apposition to a plunger device in cross-sectional  
27 view within the lumen of an insertion device shown in  
28 cross-sectional view embedded within a piece of soft  
29 tissue.

30 Figure 61 is an isolated enlarged view of the lower  
31 portion of an insertion device shown in cross-sectional  
32 view embedded in soft tissue material within which are  
33 found the plunger device shown in cross-sectional view and  
34 part of the fourth embodiment of the instant invention when  
35 downward pressure is applied to the plunger device as the  
36 insertion device is being withdrawn.

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1       Figure 62 is an isolate view of the barbed top portion  
2 biting into soft tissue when downward pressure is applied  
3 to the plunger device as the insertion device is being  
4 withdrawn.

5       Figure 63 shows the action of the second, third,  
6 fourth, and fifth embodiments of the invention in respect  
7 biting into tissue as the process referenced in Figure 62  
8 is continued.

9       Figure 64 shown the further biting into soft tissue by  
10 the second, third, fourth, and fifth embodiments of the  
11 instant invention as upward pulling pressure is applied to  
12 the suture material affixed thereto.

13       Figure 65 is a close-up isolated view of the bite into  
14 soft tissue by the centrally positioned barbed tooth of the  
15 fourth embodiment of the instant invention.

16       Figure 66 is an isolated view of the resultant  
17 anchoring within soft tissue of suture material by virtue  
18 of completion of the process described in Fig. 65 above.

19       Figure 67 shows in plan view the manner in which suture  
20 thread can be threaded through the holes of the instant  
21 invention's third embodiment in contemplation of its being  
22 used along as a suture anchoring device.

23       Figure 68 shows suture material threaded as seen in  
24 Fig. 67 but in tip plan view.

25       Figure 69 shows suture material threaded as seen in  
26 Fig. 67 but in front plan view.

27       Figure 70 shows in plan view, suture material threaded  
28 through suture holes in the inclined base of the instant  
29 invention's third embodiment.

30       Figure 71 is a bottom plan view of what is seen in Fig.  
31 70.

32       Figure 72 is a perspective view showing the manner in  
33 which suture thread can be threaded through the holes of  
34 the instant invention's third embodiment in contemplation  
35 of its being used alone as a suture anchoring device.

36       Figure 73 shows in plan view, the third embodiment of



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1 the instant invention about to be inserted into the lumen  
2 of an insertion device shown in cross-sectional view.

3 Figure 74 shows in plan view the third embodiment of  
4 the instant invention in apposition to a plunger device  
5 shown in cross-sectional view within the lumen of an  
6 insertion device shown in cross-sectional view.

7 Figure 75 shows downward pressure on a plunger device  
8 shown in cross-sectional view concomitant with withdrawal  
9 of an insertion device shown in cross-sectional view within  
10 a piece of soft tissue and commencement of the toggling of  
11 the third embodiment of the instant invention.

12 Figure 76 shows continued downward pressure on a  
13 plunger device shown in cross-sectional view concomitant  
14 with upward pressure on suture material tied to the third  
15 embodiment of the instant invention in furtherance of the  
16 toggling of the third embodiment of the instant invention.

17 Figure 77 shows the third embodiment of the instant  
18 invention subsequent to completion of the process depicted  
19 in Fig. 76 wherein the third embodiment is ready to serve  
20 as an anchor within soft tissue.

21 Detailed Description of Preferred Embodiments

22 Figure 1 shows the three components of the first  
23 embodiment of the invention, guide wire 13, proximal wedge  
24 component 14, and distal wedge component 15 fastened  
25 together to thus constitute the whole of this embodiment of  
26 the instant invention. Figure 2 shows in frontal view the  
27 proximal wedge component 14 of this embodiment of the  
28 instant invention. Its cylindrically shaped head 1 is  
29 shown as well as its lateral side 2 in terms of how  
30 proximal wedge 14 is ultimately positioned as an anchor  
31 component within a hole drilled in bone which side 2 is  
32 made up of a plurality of serrated edges. Also shown is  
33 its stop face 5 extending at an obtuse angle out from the  
34 top of its inclined medial face 6 which face 6 is shown in  
35 Figure 3 and again in Figure 7. Figure 3 shows two suture  
36 grooves 3 and 3a in the medial side of proximal wedge 14,

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1 to wit, the side of wedge 14 opposite in position to  
2 lateral side 2 once ultimately anchored in bone as well as  
3 a guide wire exit hole 4a in the medial face 6 of the  
4 proximal wedge. Figure 4 shows lateral side 2 of proximal  
5 wedge 14 as well proximal wedge 14's cylindrically shaped  
6 head 1. Figure 5 shows lateral side 2, guide wire hole 4  
7 and stop face 5 of proximal wedge 14 in a longitudinal  
8 cross section view. Figure 6 is a top view of proximal  
9 wedge 14 in which there is seen a top view of its  
10 cylindrically shaped head 1, guide wire entry hole 4  
11 centrally located therein and a top view of proximal wedge  
12 14's two identical suture grooves 3 and 3a. Figure 7 is a  
13 perspective view of proximal wedge 14 wherein there is  
14 shown all of its features as depicted in Figures 2-6  
15 inclusive. Figure 8 is a view of the medial side of the  
16 distal wedge component 15 of the first embodiment of the  
17 instant invention, to wit, that side of distal wedge 15 in  
18 apposition to the medial side of proximal wedge 14 once  
19 wedges 14 and 15 are firmly anchored in bone. Therein  
20 shown are two identical suture entry and re-exit holes 7  
21 and 7a respectively as well as a guide wire entry hole 4b  
22 and its inclined medial face 11. Figure 9 is a frontal  
23 view of distal wedge 15 in which there is seen its beveled  
24 top edge 9 and two identical suture exit and re-entry  
25 holes, 8 and 8a respectively in the inclined face 12 of its  
26 base. Figure 11 is a cross-sectional lateral view showing  
27 the beveled top edge 9 of distal wedge 15. It should be  
28 noted that the angle of beveling is constant to each of two  
29 points in the top edge of distal wedge 15 both equidistant  
30 from the center of the top edge from which points the angle  
31 of bevel tapers to zero degrees. Figure 12 shows the  
32 inclined base face 12 of distal wedge 15 as well as guide  
33 wire exit hole 4c and suture exit hole 8 and suture re-  
34 entry 8a. Figure 13 is a longitudinal cross-sectional view  
35 of distal wedge 15 showing its stop face 10, guide wire  
36 entry hole 4b, the canal therein leading therefrom to its

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1 guide wire exit hole 4c and dotted lines depicting the  
2 locus of the canal therein from its suture entry hole 7 to  
3 its suture exit hole 8. Figure 14 shows distal wedge 15 in  
4 perspective view wherein there is to be seen its suture  
5 entry hole 7, its suture re-exit hole 7a, its guide wire  
6 entry hole 4b, its stop face 10 and its medial face 11.  
7 Figure 15 is a view of a piece of bone E into which a hole  
8 is to be drilled with resort a cannulated drill bit A.  
9 Once a hole is drilled into bone E, the drill which was  
10 used is separated from the cannulated drill bit A and guide  
11 wire component 13 is threaded through the canal in drill  
12 bit A. Guide wire 13 is threaded down to the base of the  
13 drilled hole typically drilled deep enough into bone to  
14 pass into deep bone F below the outer cortex E of the bone.  
15 Figure 16 shows in cross-sectional view, bone cortex E and  
16 a deeper layer F of bone. The arrow in Figure 16 shows  
17 removal to the drill bit A from guide wire 13 after  
18 proximal wedge 14 and distal wedge 15 have first been  
19 removed therefrom prior to their being repositioned as they  
20 would be on guide wire 13 once drill bit A is fully removed  
21 therefrom. Figure 17 shows guide wire 13 passing through  
22 guide wire entry hole 4 in the cylindrically shaped head 1  
23 of proximal wedge 14 and out through its guide wire exit  
24 hole 4a. Figure 18 shows suture thread B passing through  
25 suture entry hole 7 of distal wedge component 15 and down  
26 through the canal between hole 7 and suture exit hole 8  
27 from which suture thread B emanates before reentering  
28 distal wedge 15 through suture re-entry hole 8a and suture  
29 re-exit hole 7a from which it emanates. Figure 19 shows in  
30 cross-sectional view, guide wire 13 coursing through guide  
31 wire entry hole 4 in head 1 of proximal wedge 14 down  
32 through the canal therein leading from hole 4 to guide wire  
33 exit hole 4a and into guide wire entry hole 4b in distal  
34 wedge 15 and down through the canal therein leading from  
35 hole 4b to guide wire exit hole 4c in the base of the  
36 distal wedge. There is also to be noted in Figure 19

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1 suture thread B as it would be found passing via suture  
2 groove 3a found on the side of proximal wedge 14 opposite  
3 the lateral side 2 thereof and into suture entry hole 7 of  
4 distal wedge 15 and out suture exit hole 8 thereof. That  
5 which is depicted in Figure 19 is depicted in part in  
6 Figure 20 as well. Figure 21A shows an insertion tool with  
7 a retractable sleeve C. Figure 21B shows sleeve C of the  
8 insertion tool retracted so that its jaw D opens. Figure  
9 22 shows guide wire 13 threaded through the insertion tool  
10 and proximal wedge 14 and distal wedge 15 and coursing  
11 beyond them as it would be leading to the bottom of the  
12 previously drilled hole. Figure 23 shows sleeve C of the  
13 insertion tool engaged over its jaw D in preparation for  
14 pushing down on head 1 of proximal wedge 14. Figure 24  
15 depicts in perspective view what is shown in Figure 23.  
16 Figure 25 shows guide wire component 13, proximal wedge 14  
17 and distal wedge 15 components of the first embodiment of  
18 the instant invention in apposition to the hole previously  
19 drilled into bone cortex E wholly circumscribing deeper  
20 bone F and the arrow therein shown depicts the direction of  
21 its insertion into the bone. Figure 26 shows wedge  
22 components 14 and 15 of the first embodiment of the  
23 invention after having been pushed with the insertion tool  
24 into the hole previously drilled in bone and the arrow  
25 therein shown depicts the direction of removal of guide  
26 wire 13 once wedge components 14 and 15 are positioned in  
27 the hole previously drilled in bone. At this juncture, it  
28 should be noted that proximal wedge 14 and distal wedge 15,  
29 previously threaded with suture thread B as described above  
30 and repositioned on guide wire 13 below an insertion tool  
31 after guide wire 13 would have first been threaded through  
32 a cannulated drill bit into a hole drilled in bone and the  
33 cannulated drill bit removed from the hole and slipped up  
34 and off guide wire 13, are ready for permanently wedged  
35 insertion into the hole drilled in bone by way of the  
36 combined actions of pushing down on the head 1 of proximal

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1 wedge 14 in-situ with the insertion tool while at the same  
2 time pulling up on suture thread B. Figure 27 shows the  
3 left thumb G and left index finger H of a surgeon pushing  
4 down on the head 1 of proximal wedge 14 with the insertion  
5 tool with downward force and Figure 27 also shows the right  
6 thumb I and right index finger J of the surgeon beginning  
7 to pull on the two strands of suture thread B that were  
8 previously shown passing through suture entry hole 7 of  
9 distal wedge 15 out its suture exit hole 8 passing  
10 therefrom along its inclined base face 12 and back through  
11 its suture re-entry hole 8a of and up through the distal  
12 wedge 15 and out its suture re-exit hole 7a. Inclined base  
13 face 12 of distal wedge 15 serves to prevent suture thread  
14 B from coming into contact with guide wire 13 as it would  
15 be emanating from hole 4c in the base of distal wedge 15.  
16 Figure 28 shows the same digits of the same surgeon pushing  
17 down with the insertion tool on head 1 of proximal wedge 14  
18 and simultaneously pulling on suture thread B. Figure 29  
19 shows how the two wedge components 14 and 15 of the first  
20 embodiment of the invention are positioned together and  
21 firmly anchored within the hole previously drilled in bone  
22 once the surgeon has completed the above-described process  
23 of pushing and pulling. Figure 30 is a blown up view of  
24 the inserted wedge components 14 and 15 of the first  
25 embodiment of the instant invention. The arrows M,N and O  
26 depict how force emanates laterally against the walling of  
27 the hole drilled in bone as a result of downward force L  
28 applied to head 1 of proximal wedge 14 being combined with  
29 upward force K due to the pulling up on the strands of  
30 suture thread B. The combined pushing and pulling causes  
31 the plurality of serrated edges of lateral side 2 of  
32 proximal wedge 14 to bite firmly into the bone adjacent  
33 thereto in view of the resultant upward sliding action of  
34 distal wedge 15 against proximal wedge 14 whereby the  
35 inclined face 6 of proximal wedge 14 previously in  
36 apposition to the medial aspect of distal wedge 15 comes

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1 into interfaced contact with the inclined face 11 of the  
2 distal wedge 15 such that the central diameter of the two  
3 wedge components 14 and 15 in apposition to one another is  
4 significantly increased. Also, beveled top side 9 of  
5 distal wedge 15 cuts into bone in apposition to it in  
6 response to such concomitant pushing and pulling to thereby  
7 contribute to anchoring and beveled to side 9 together with  
8 stop face 5 of proximal wedge 14 and stop face 10 of distal  
9 wedge 15 serve to prevent either wedge from sliding by the  
10 other during the application of forces L and K to thereby  
11 serve to defeat the intended purpose of increasing the  
12 central diameter of the two wedge components 14 and 15 in  
13 apposition to one another which increasing of the central  
14 diameter is what causes the laterally directed biting and  
15 cutting described above which in turn is responsible for  
16 the permanent positioning in the hole drilled in bone of  
17 wedge components 14 and 15 of the invention, to thus result  
18 in a firmly and permanently situated suture anchor in bone.  
19 Figure 31 shows human or other animal soft tissue P held  
20 fast to bone by suture thread B tied thereabout such tissue  
21 P and concomitantly threaded through and about the distal  
22 wedge component 15 of the firmly and permanently situated  
23 instant suture anchor.

24 Figure 67 is a plan view of the side of the second  
25 preferred embodiment of the instant device that is  
26 characterized by the presence of the device's two suture  
27 entry holes, hole 101 and hole 102, its suture exit hole  
28 103b, its barbed tip 105 located in its top portion and its  
29 centrally located lower tooth 106 within a rounded out  
30 notch 107 in the lowest part of the lower portion 122 of  
31 this side, to wit, of the device's only side that has holes  
32 in it. Barbed tip 105 located in the device's top portion  
33 serves to pierce into tissue on one side of a pierced  
34 insertion hole opposite to the side of the hole bitten into  
35 by lower tooth 106 as seen in Figure 77 after the  
36 embodiment is threaded as shown with suture material C' and

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1 suture material C' is threaded through a hollow plunger B',  
2 an example of which is seen in Fig. 73 and then inserted  
3 along with plunger B' into the lumen of insertion device A'  
4 as shown in Fig. 74, and then after soft tissue D' is  
5 pierced with insertion device A' and then downward pressure  
6 is applied to plunger B' as insertion device A' is  
7 withdrawn as seen in Fig. 75 followed by continued downward  
8 pressure on plunger B' and upward pressure on suture  
9 material C' as shown in Fig. 76. Once anchoring in soft  
10 tissue D' is accomplished as shown in Fig. 77, then soft  
11 tissue D' is amenable to being sutured to to the soft  
12 tissue in close proximity thereto with virtually no fear  
13 that the sutured tissues will later come apart due to  
14 failure of suturing to hole the tissues together. Fig. 68,  
15 Fig. 69, Fig. 70 and Fig. 71 show how suture material C' is  
16 threaded through suture entry holes 101 and 102 and down  
17 through the body of the embodiment and out through suture  
18 exit holes 101b and 102b respectively in the inclined  
19 portion of the base 124 of the embodiment and then out  
20 through suture exit hole 103b located in the upper portion  
21 120 of the side of this embodiment characterized by the  
22 presence of suture entry holes 101 and 102 with hole 103b  
23 located between and below holes 101 and 102. The nexus  
24 102a between holes 102 and 102b and the nexus 103a between  
25 holes 103 and 103b are seen in Fig. 43. Rotation of Fig.  
26 43 through an angle of 180 degrees would disclose a  
27 separate nexus between holes 101 and 101b equivalent in  
28 dimension to that of nexus 102a. It has been noted to be  
29 the case that it is singularly important to run the ends of  
30 suture material C' exiting hole 103b under the arch or  
31 suture material C' formed when suture material C' is  
32 initially threaded through holes 101 and 102 in order to  
33 minimize the toggling effect on the embodiment as suture  
34 thread C' is pulled upwards with downward pressure applied  
35 to plunger B' as seen in Fig. 76. Fig. 75 shows in  
36 perspective view what is depicted in Fig. 67.

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1 Figs. 39-45 inclusive excepting Fig. 43 depict the  
2 various views of the preferred embodiment of the instant  
3 invention as are seen in Fig. 67-72 inclusive but without  
4 the suture material C' threaded through the various holes  
5 present within the embodiment. Figs. 32-38 inclusive  
6 depict various view of another embodiment of the instant  
7 invention. This latter embodiment lacks the centrally  
8 located lower tooth 106 and notch 107 of the preferred  
9 embodiment. This other latter embodiment can be utilized  
10 in conjunction with the preferred embodiment, for example,  
11 for embedding in bone when one might be seeking to hole a  
12 grater tissue load than an anchor made up of only one wedge  
13 embodiment, to wit, the preferred embodiment alone. As  
14 might be expected, two exemplars of the preferred  
15 embodiment could be utilized for purposes of constructing  
16 such a relatively stronger anchor. This latter embodiment  
17 does not have the overall holding capacity of the preferred  
18 embodiment, but, it is somewhat less expensive to  
19 manufacture due to its relative simplicity of design.  
20 Figs. 46-52 inclusive depict yet a fourth embodiment of the  
21 instant invention. This fourth embodiment is simpler in  
22 design than the former two and is less expensive to  
23 manufacture. An even simpler embodiment, to wit, the lowe  
24 of the two embodiments utilized for anchoring purposes as  
25 seen in Fig. 56 and 57 resembles the fourth embodiments but  
26 lacks the centrally located lower tooth 106 and notch 107  
27 of the third embodiment. These latter two embodiments lack  
28 paired lateral suture holes 101 and 102 and paired suture  
29 holes 101b and 102b on the bases of these embodiments and  
30 correspondingly lack as well nexus' between holes 101 and  
31 101b, to wit 101a and between holes 102 and 102b, to with  
32 102a. Figs. 53-57 inclusive demonstrate how these latter  
33 two embodiments would be tied together with suture material  
34 C', placed below plunger B' through which suture material  
35 C' would have been threaded and placed in-toto within the  
36 lumen of insertion device A'. Device A' is then inserted



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1 into tissue D' as per Figs. 58, 59 and 60. Withdrawal of  
2 the device A' coupled with downward pressure on plunger B'  
3 constitutes commencement of the process that ultimately  
4 causes the wedge system to be toggled wedged into tissue  
5 D'. Barbed tip 105 pierces into tissue D' as seen in Figs.  
6 61 and 62. Fig. 63 illustrates the commencement of such  
7 toggle anchoring with withdrawal of device A' coupled with  
8 downward pressure on plunger B'. Fig. 64 shows completion  
9 of toggle anchoring with upward pulling pressure on suture  
10 thread C' as plunger B' is concomitantly withdrawn. Fig.  
11 65 shows in isolated view, tooth 106 having bitten into  
12 tissue D' on the wall of tissue D' opposite to the wall  
13 pierced by barbed tip 105. Fig. 66 shows a fully  
14 constructed suture anchor with the inclined base of one  
15 wedge in apposition to the stop face 104 of a second wedge.  
16 The preferred embodiment threaded as shown previously could  
17 have been utilized in lieu of the fifth embodiment as shown  
18 in Figs. 58 through 66, and for the matter so could have  
19 the embodiment shown in Figs. 32-38 inclusive above if  
20 threaded as shown in Figs. 67 and 72, but simplicity of  
21 design and diminished cost of manufacture would be factors  
22 that would, no doubt, prompt use of the fourth and fifth  
23 embodiments for purposes of accomplishing sturdy toggle  
24 anchoring in tissue in excess of the sturdiness to be  
25 appreciated from use of the preferred embodiment alone as  
26 per the protocol evidenced with respect to Figs. 73-77  
27 inclusive. The preferred embodiment and its less expensive  
28 counterpart, to wit, the embodiment shown in Figs. 32-38  
29 could however be used in tandem to accomplish extra sturdy  
30 anchoring in bone.

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CLAIMS

1

2 What is claimed is:

3 1. A suture anchor for securing a suture (B) to a bore  
4 hole in a bone (E,F), and comprising:5 a. a distal wedge (15) for being removably mounted on  
6 a guide wire (13), said distal wedge including holes  
7 (7,7a,8,8a) for receiving said suture ; and8 b. a proximal wedge (14) for being removably mounted  
9 on said guide wire, said proximal wedge including grooves  
10 (3,3a) for receiving said suture received through said  
11 holes of said distal wedge;12 and wherein, said wedges include means (2,5,9,10) for  
13 laterally anchoring said anchor into said bone upon  
14 application of upwardly acting force (K) to said distal  
15 wedge and downwardly acting force (L) to said proximal  
16 wedge.17 2. A suture anchor according to claim 1, wherein said  
18 distal wedge (15) includes a beveled portion (9) for  
19 digging into said bone.20 3. A suture anchor according to claim 1, wherein said  
21 lateral anchoring means includes a plurality of serrated  
22 edges (2) on a lateral portion of said proximal wedge.23 4. A suture anchor according to claim 1, wherein said  
24 wedges include stop faces (5,10) adapted to mitigate  
25 sliding of said wedges over one another upon application of  
26 said forces.27 5. A suture anchor according to claim 1, wherein said  
28 wedges comprise mounting holes (4,4a,4b,4c) for receiving  
29 said guide wire, whereby to mount said wedges of said guide  
30 wire.31 6. A suture anchor according to claim 1, wherein said  
32 holes for receiving suture thread comprise two holes (7,7a)  
33 in a medial portion (11) of said distal wedge and two  
34 holes, (8,8a) in a base portion (12) of said distal wedge,  
35 said holes communicating with each other through said  
36 distal wedge.

1       7. A suture anchor according to claim 6, wherein said  
2 base portion (12) of said distal wedge is wedge-shaped.

3       8. A suture anchor, and comprising, an upper (120)  
4 and lower (122) portion, said upper and lower portions  
5 including means (105,106) for piercing into body tissue  
6 (D'), and a plurality of holes  
7 (101,102,101b,102b,103,103b) for receiving suture thread  
8 (C'), said holes being located in both said upper and  
9 lower portions, at least some of said holes being  
10 connected together so as to permit said thread to be  
11 channeled through said anchor for attaching to said anchor  
12 whereby to permit said thread to be secured to said body  
13 tissue (D').

14       9. A suture anchor according to claim 8, wherein said  
15 anchor is wedge-shaped.

16       10. A suture anchor according to claim 8, wherein  
17 said anchor includes a barbed top portion (105).

18       11. A suture anchor according to claim 8, wherein  
19 said plurality of holes includes:

20       i. two suture holes (101,102) in said upper portion;

21       ii. two laterally positioned suture holes (101B,102B)  
22 in a base portion of said body, one of said laterally  
23 positioned holes being connected to one of said holes in  
24 said upper portion, the other of said laterally positioned  
25 holes being connected to the other of said holes in said  
26 upper portion;

27       iii. a first centered hole (103B) between and below  
28 the suture holes in the upper portion; and

29       iv. a second centered hole (103) in said base portion  
30 and connected to said first centered hole.

31       12. A suture anchor according to claim 8, wherein  
32 said anchor includes an angled base portion (106,107).

33       13. A suture anchor according to claim 8, and further  
34 comprising, a centrally positioned barbed tooth (106).

35       14. A suture anchor according to claim 13, wherein  
36 said barbed tooth (106) includes a notch (107).

37       15. A suture anchor according to claim 14, wherein

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- 1 said plurality of holes includes:
- 2     i. a first centered hole (103B) between and below the
- 3 suture holes in the upper portion; and
- 4     ii. a second centered hole (103) in a base portion of
- 5 said body and connected to said first centered hole.

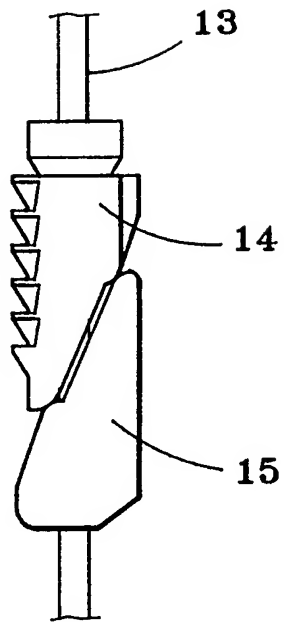


FIG. 1

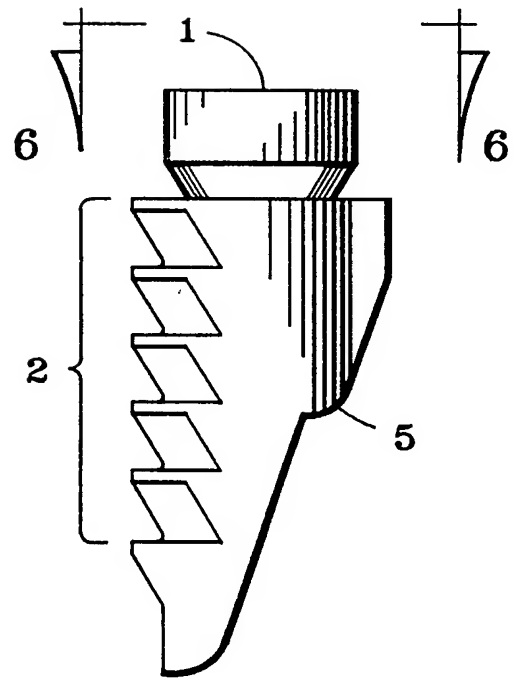


FIG. 2

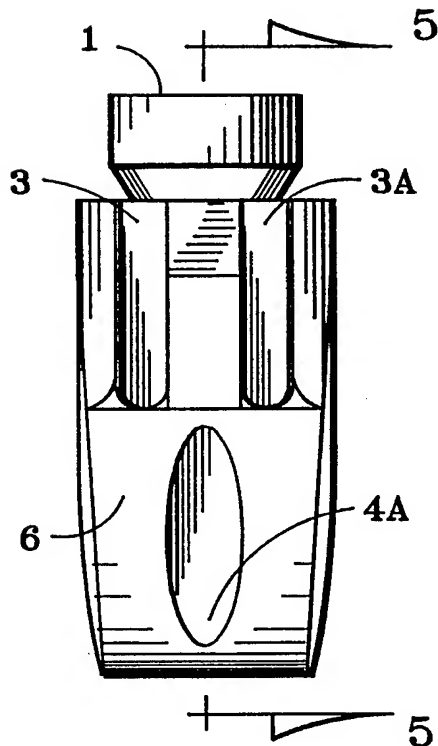


FIG. 3

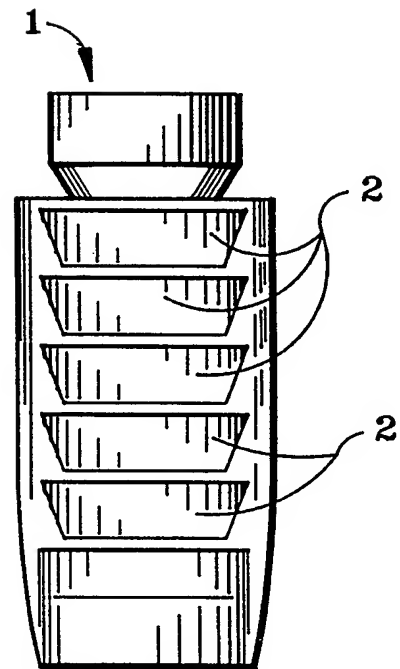
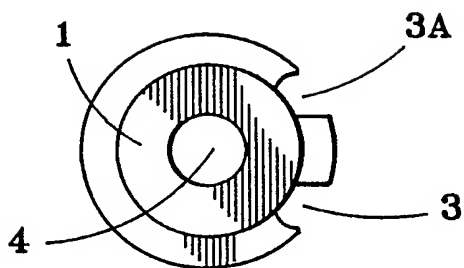
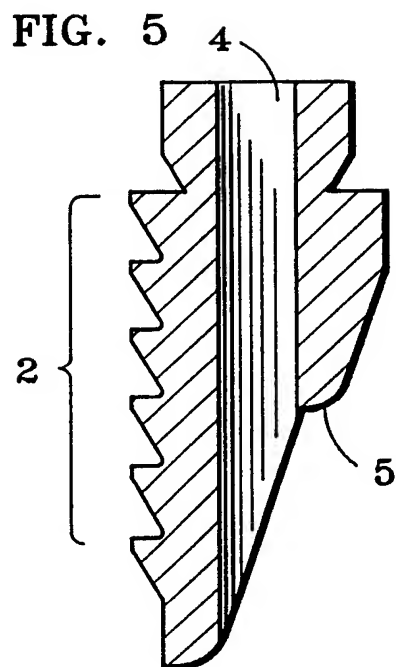
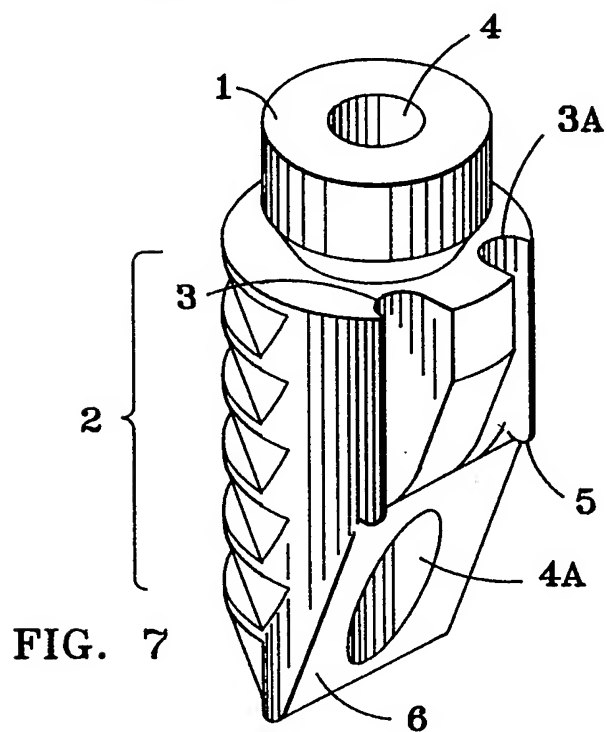


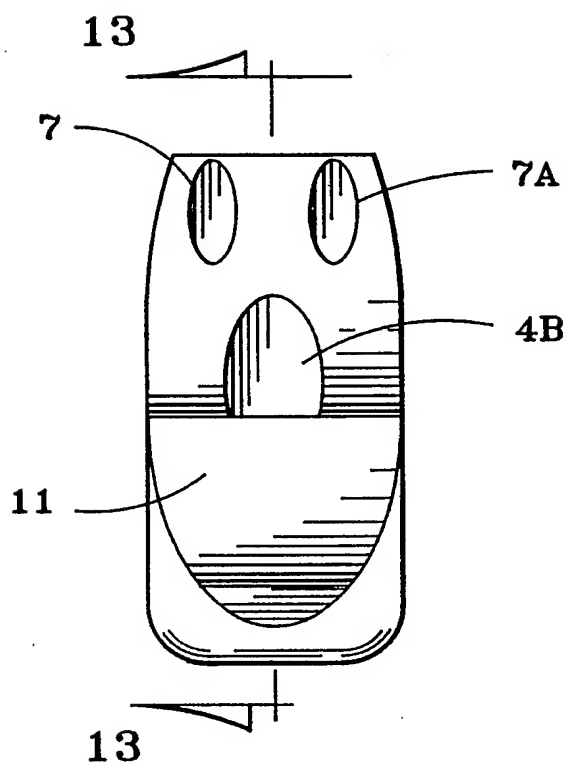
FIG. 4



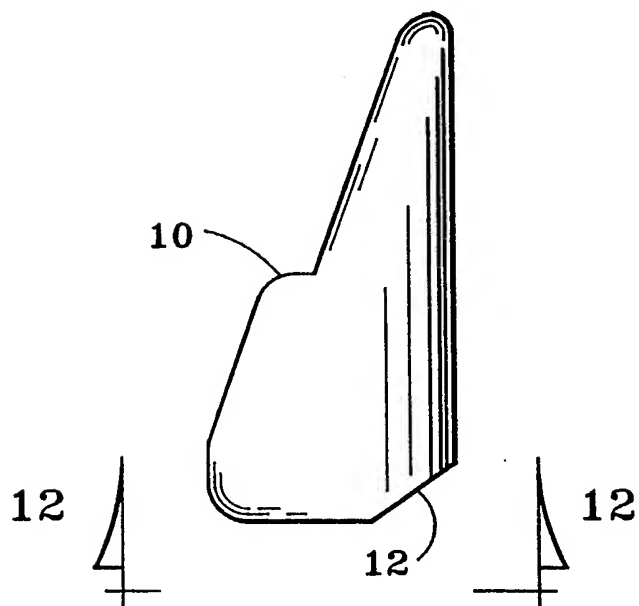
**FIG. 6**



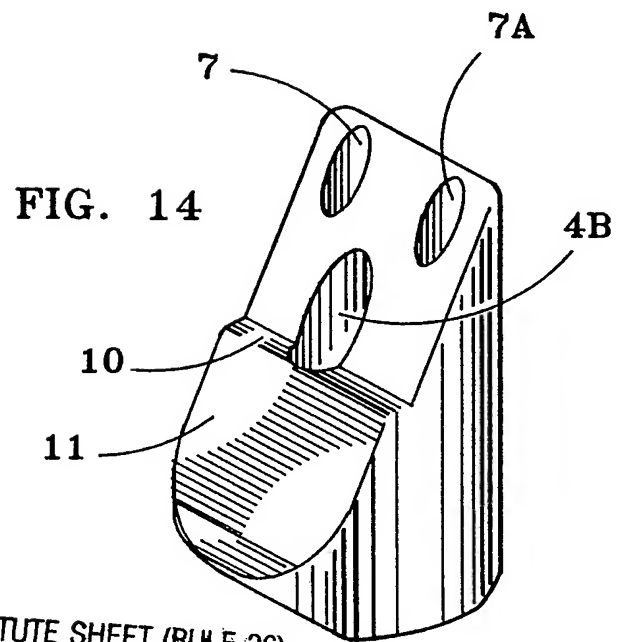
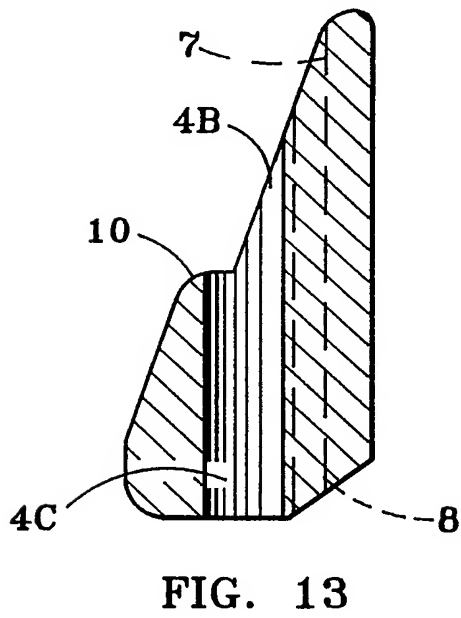
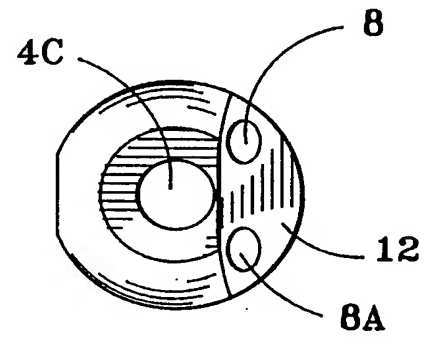
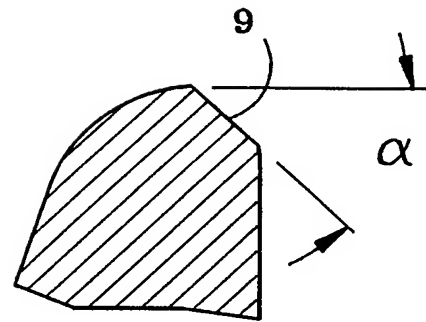
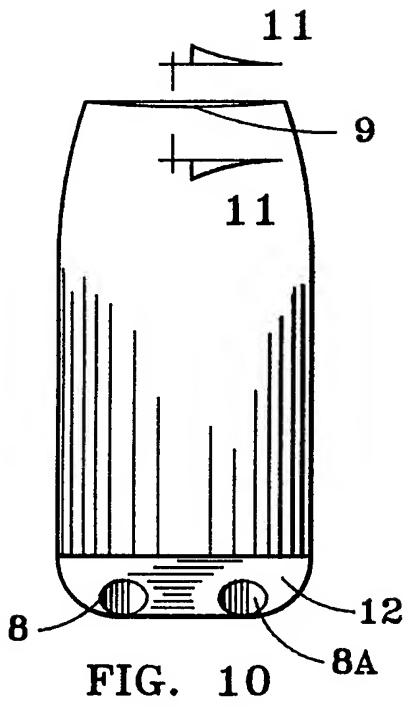
**FIG. 7**



**FIG. 8**



**FIG. 9**



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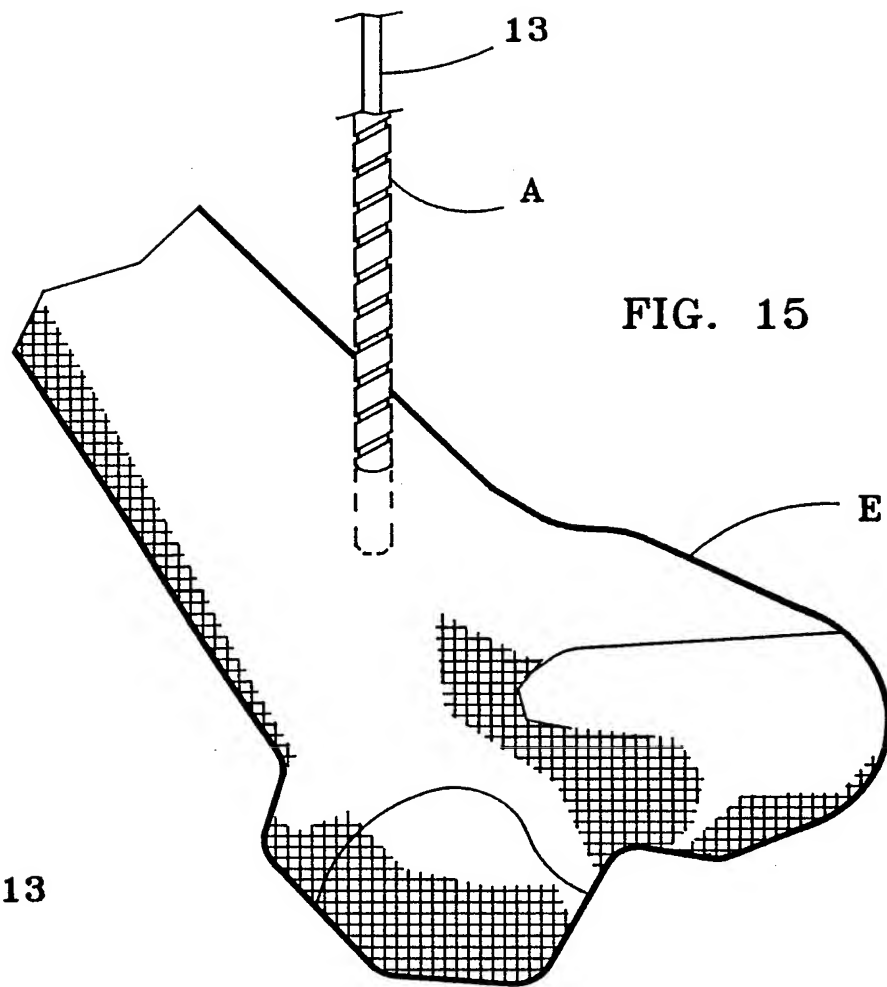


FIG. 15

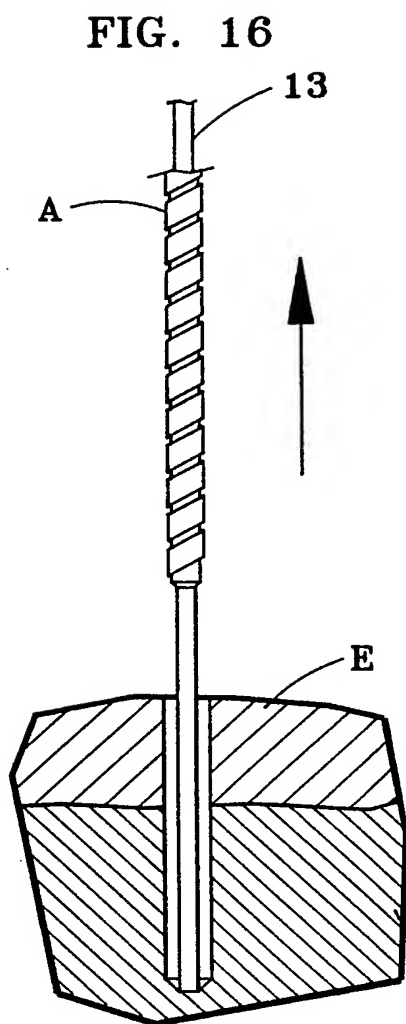


FIG. 16

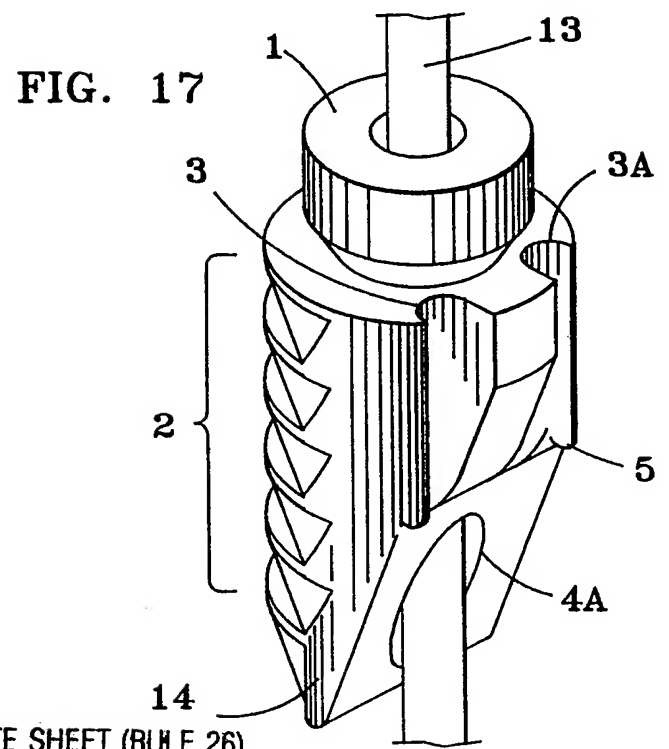
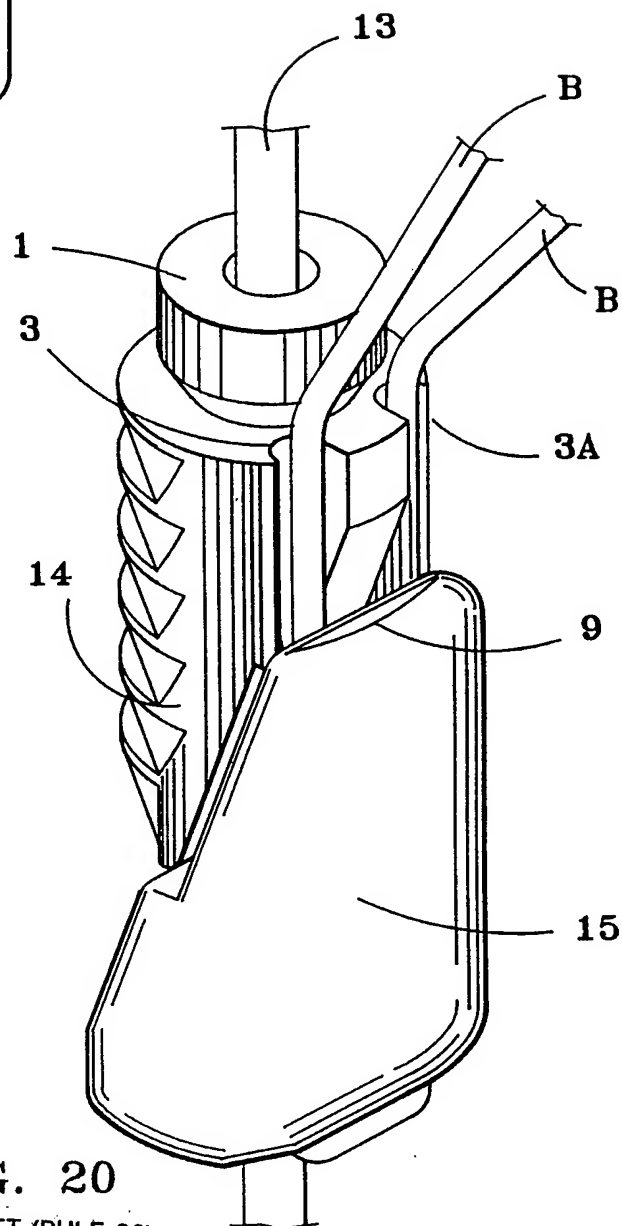
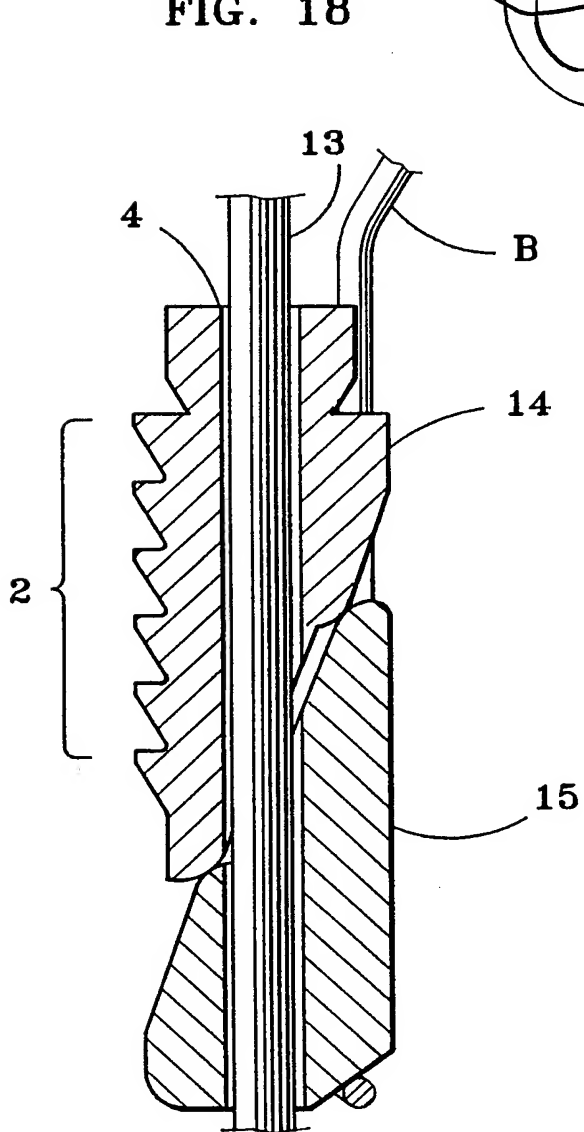
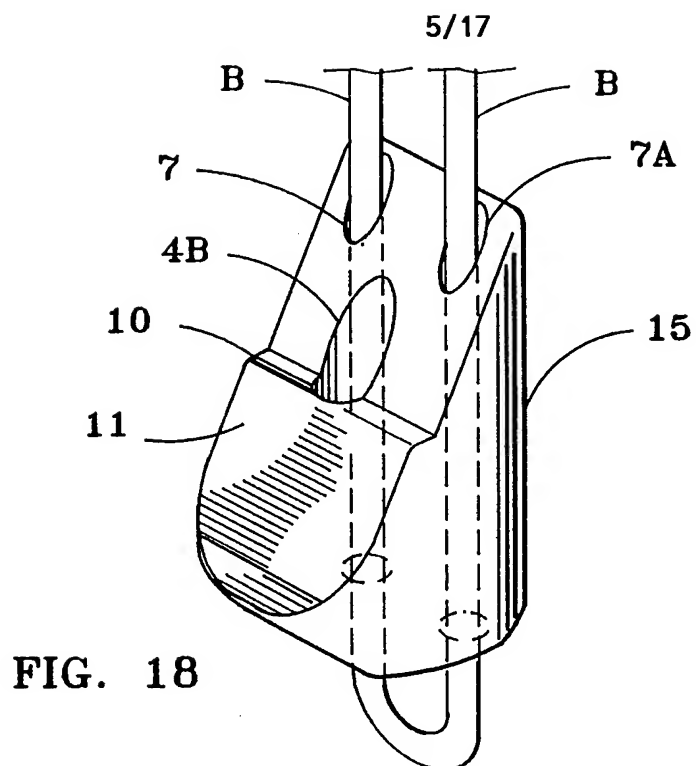


FIG. 17





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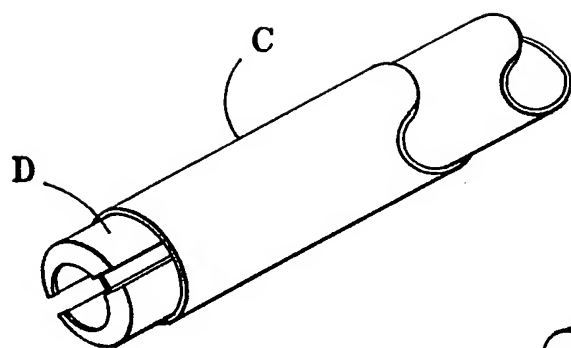


FIG. 21A

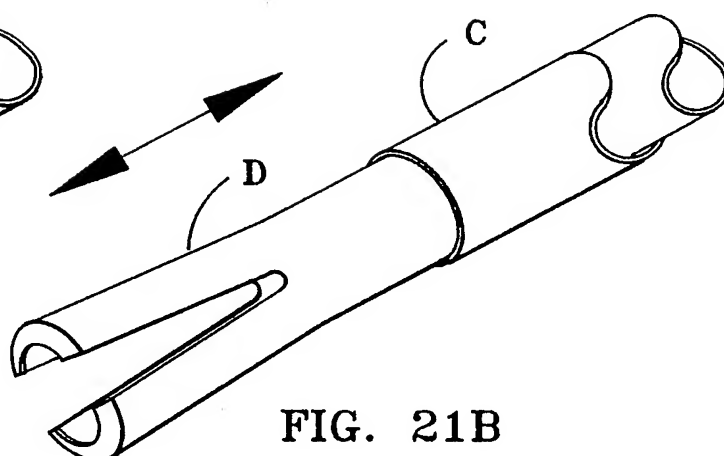


FIG. 21B

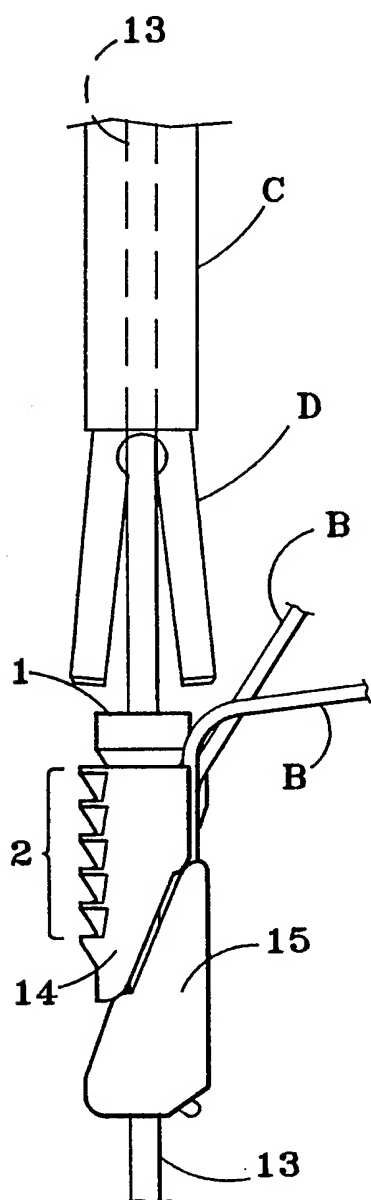


FIG. 22

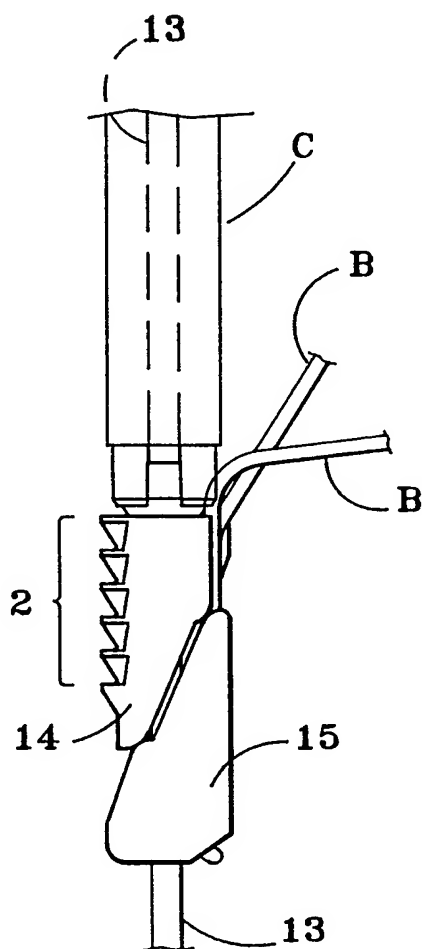


FIG. 23

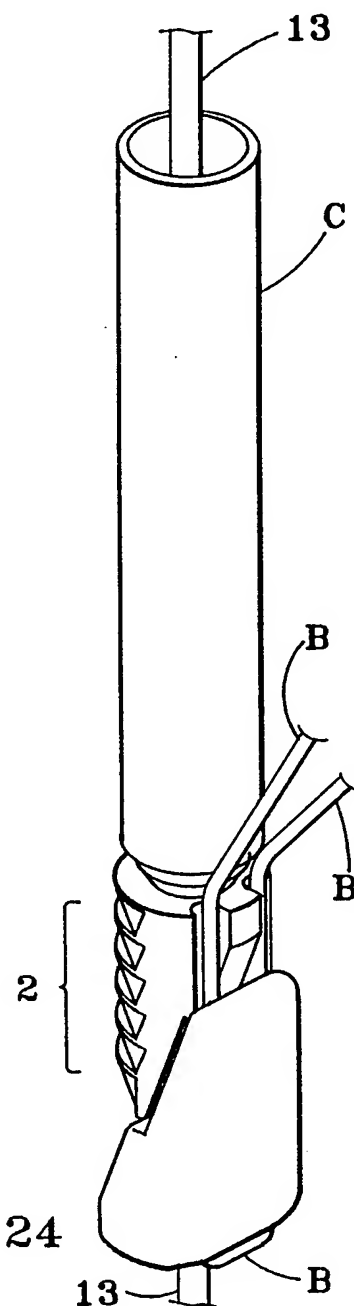
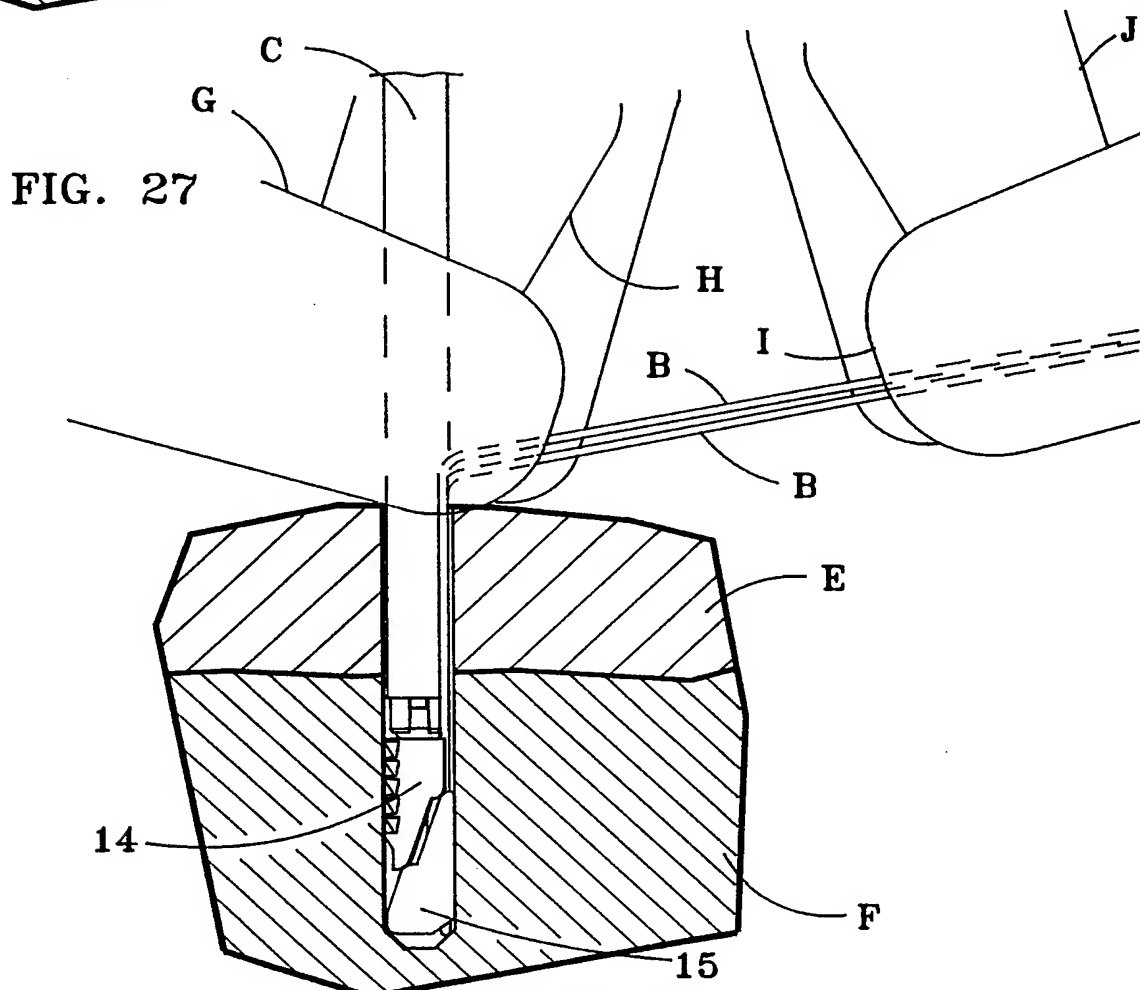
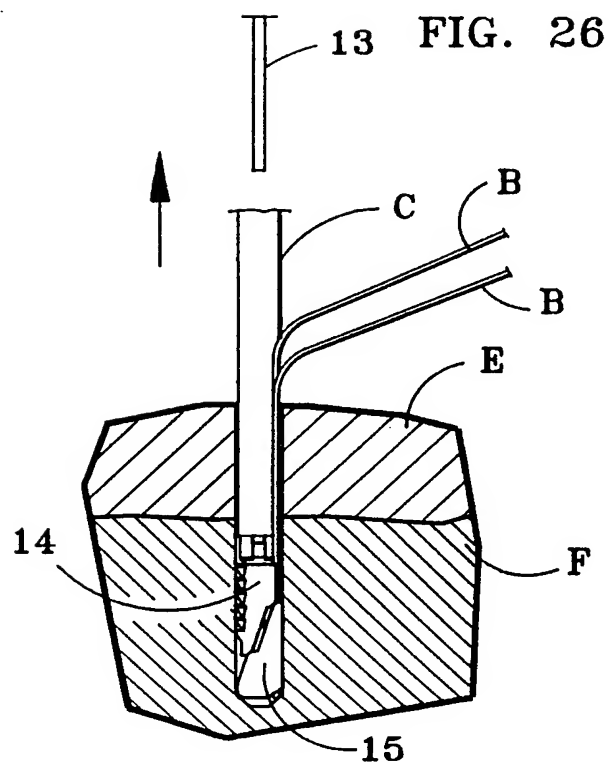
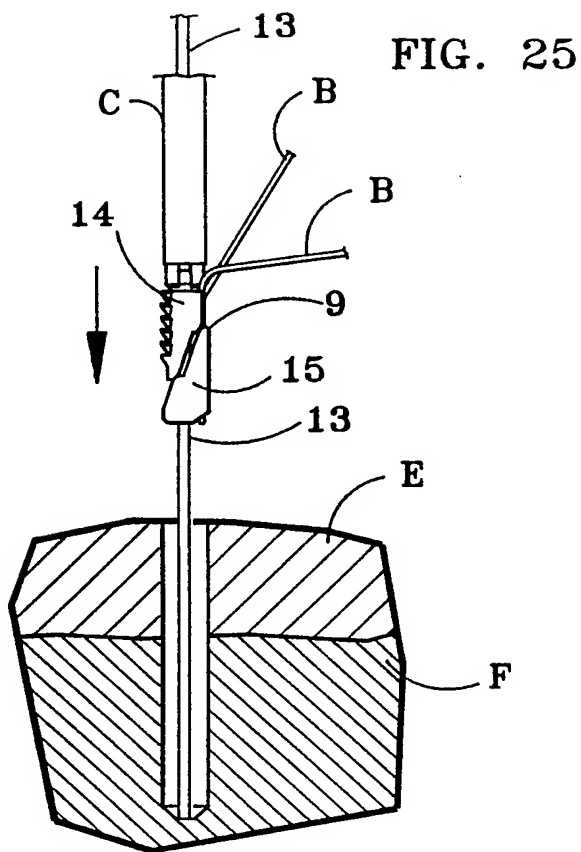


FIG. 24



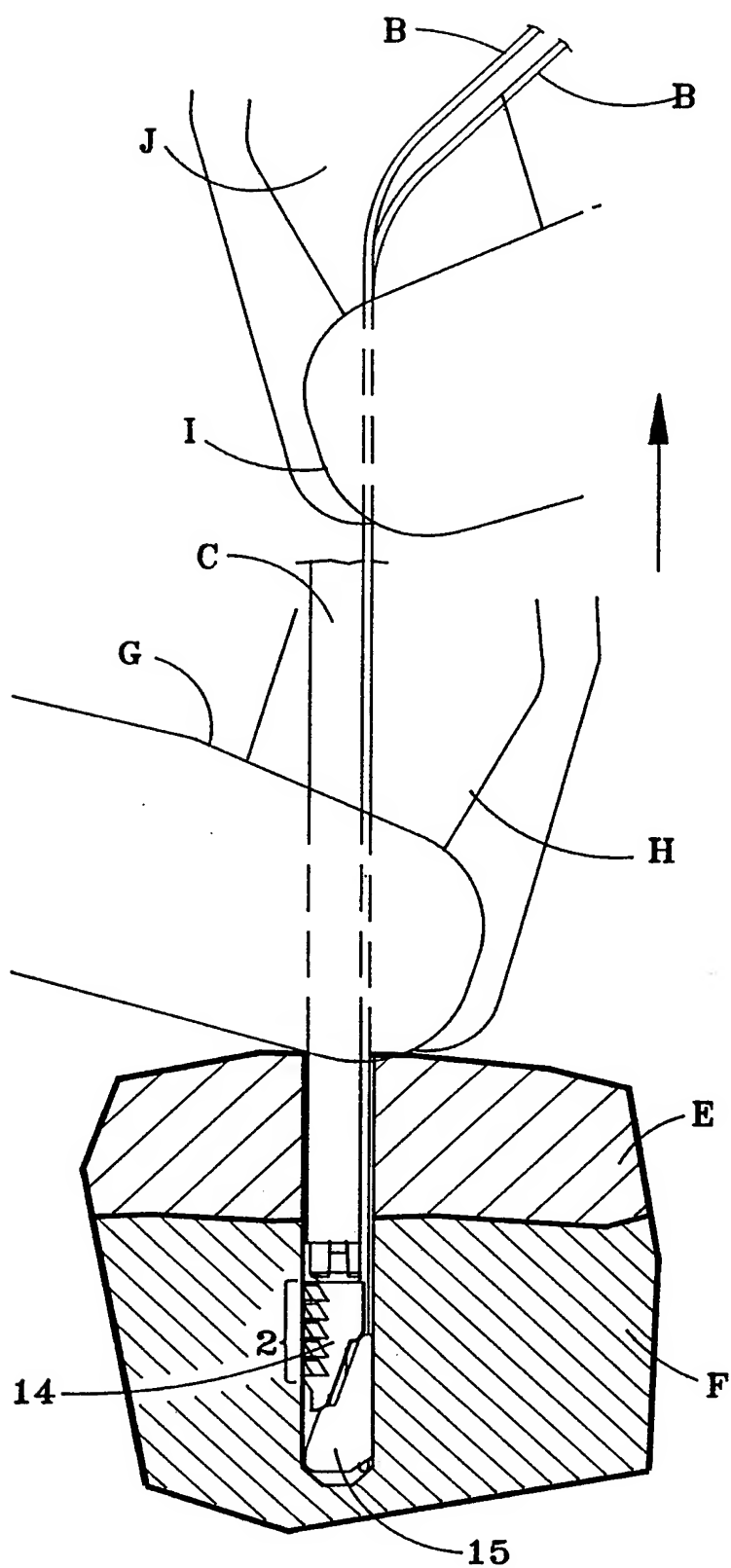


FIG. 28

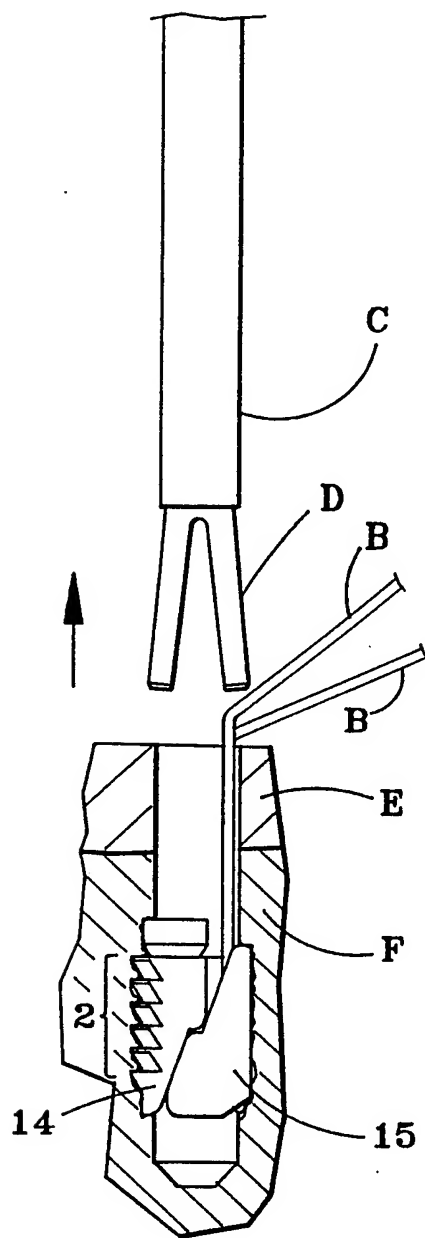


FIG. 29

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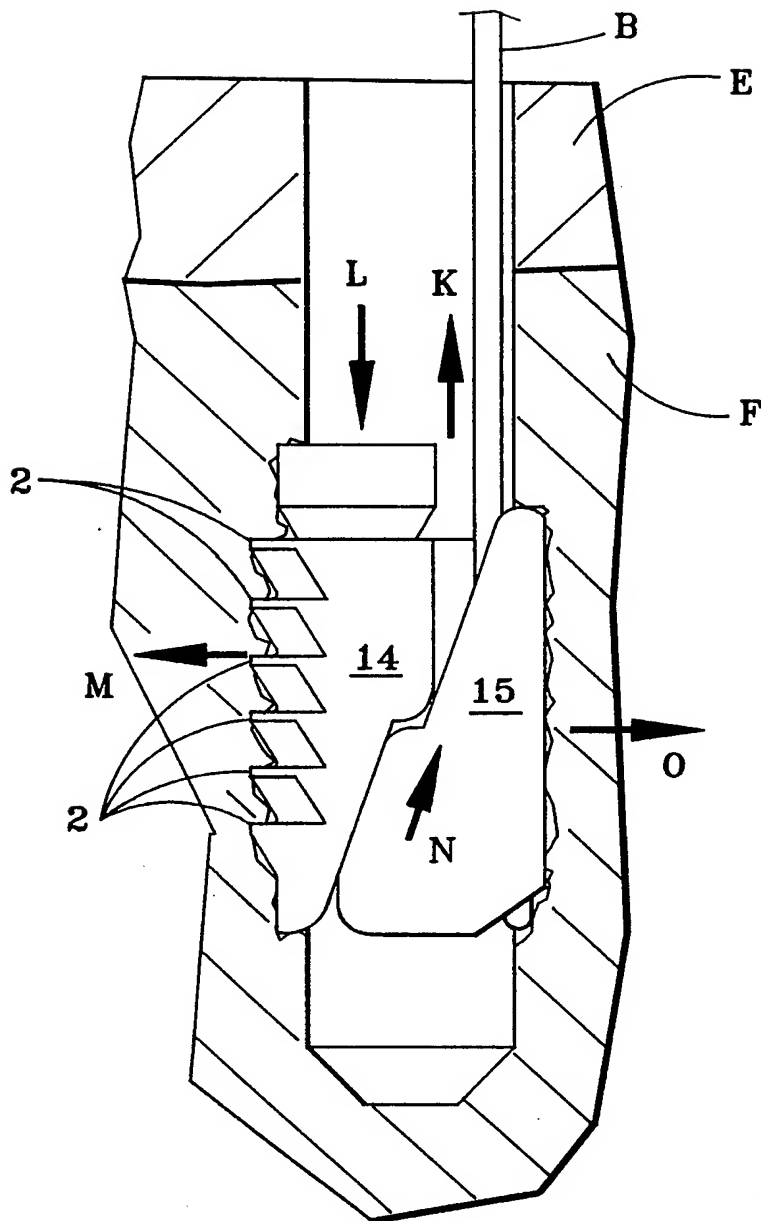


FIG. 30

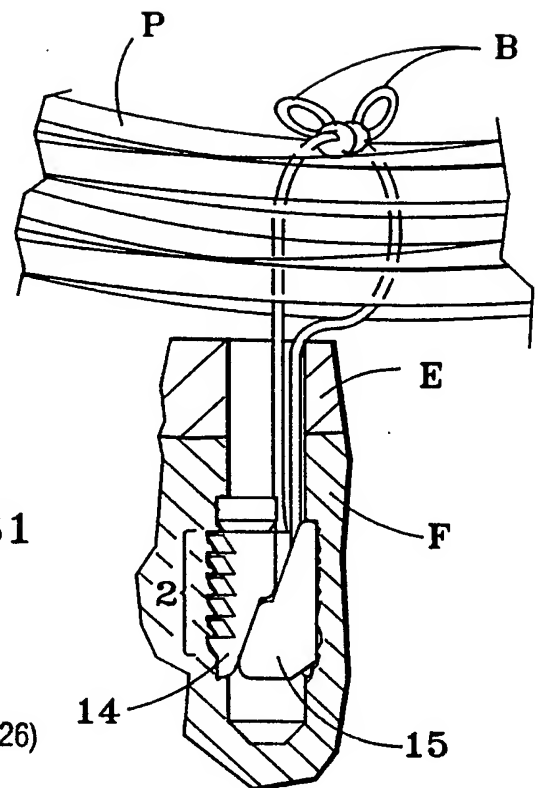


FIG. 31

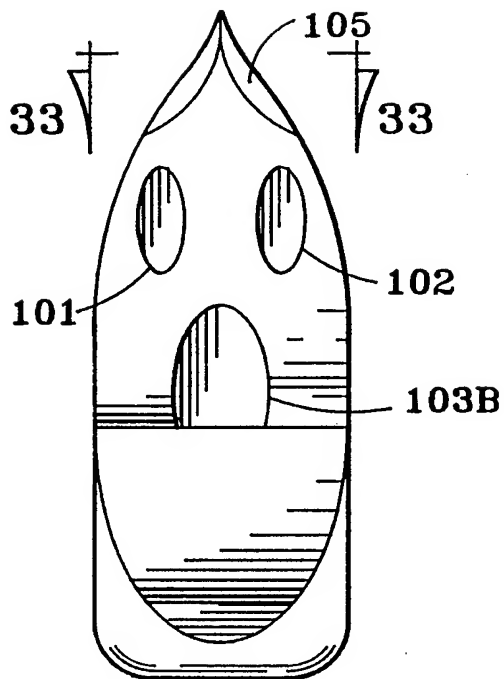


FIG. 32

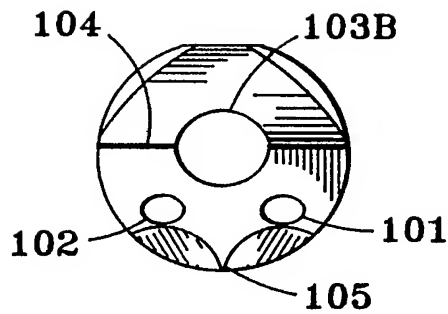


FIG. 33

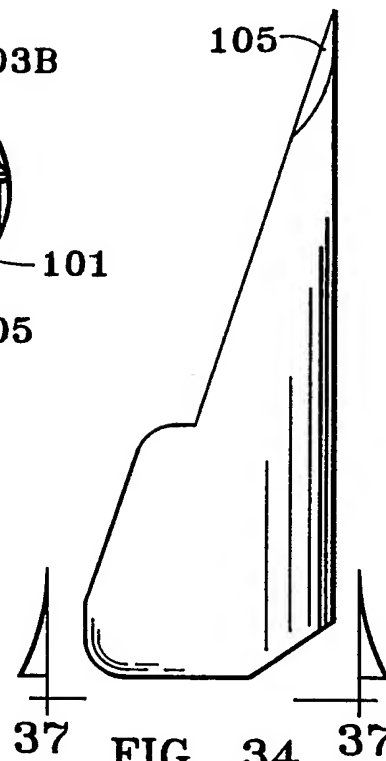


FIG. 34

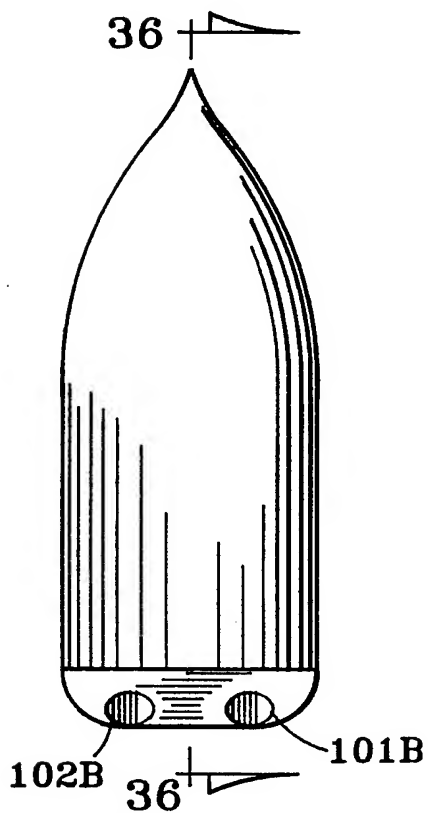


FIG. 35

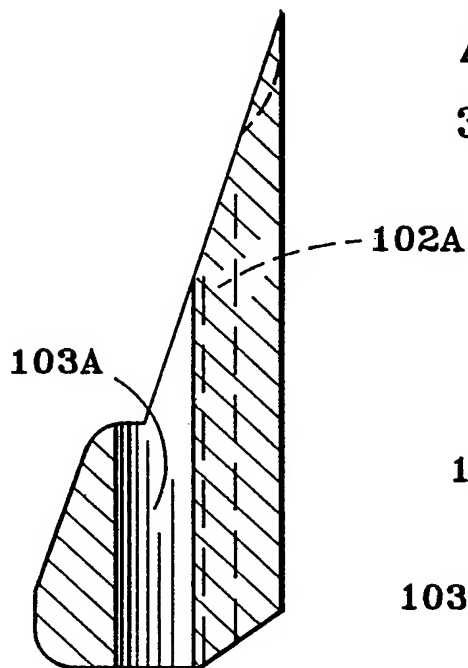


FIG. 36

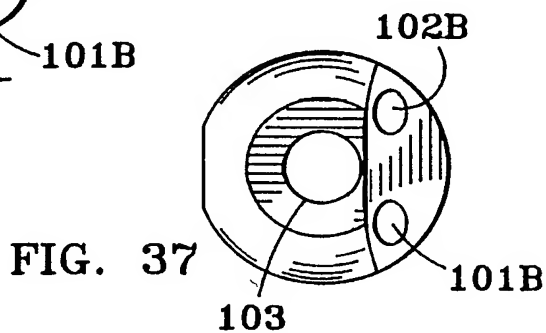


FIG. 37

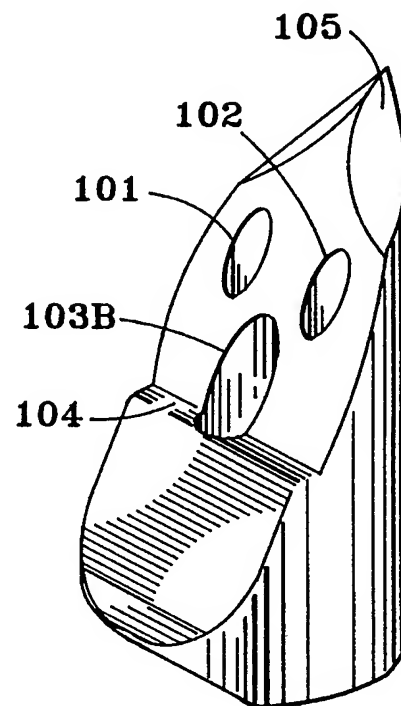


FIG. 38

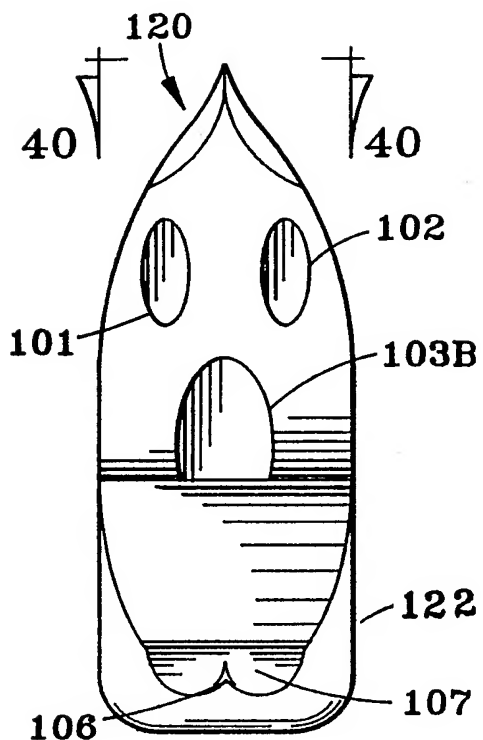


FIG. 39

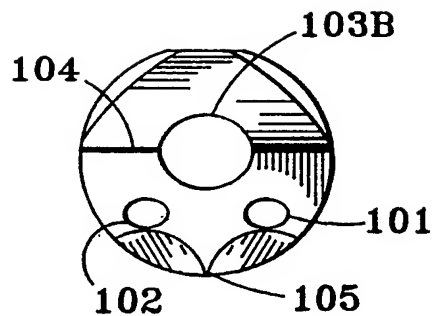


FIG. 40

FIG. 41

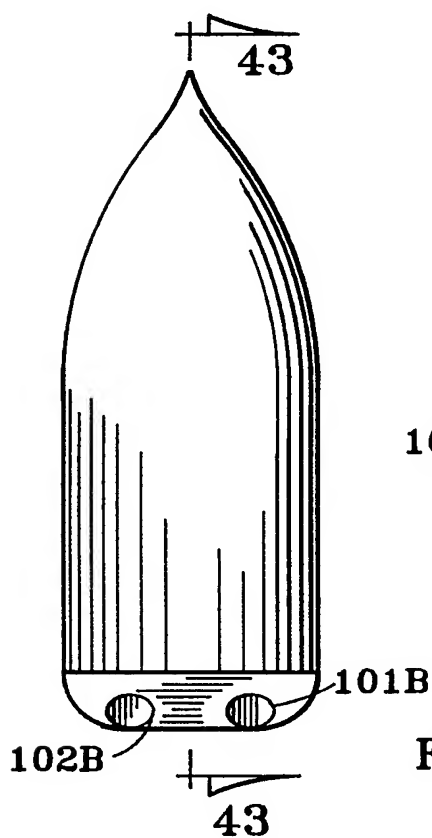
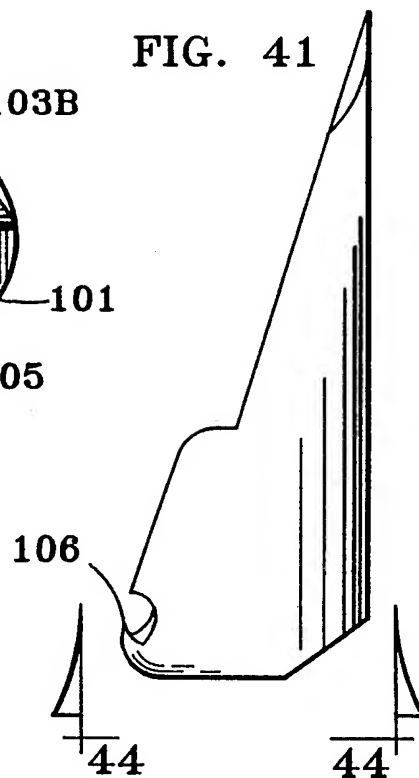


FIG. 42

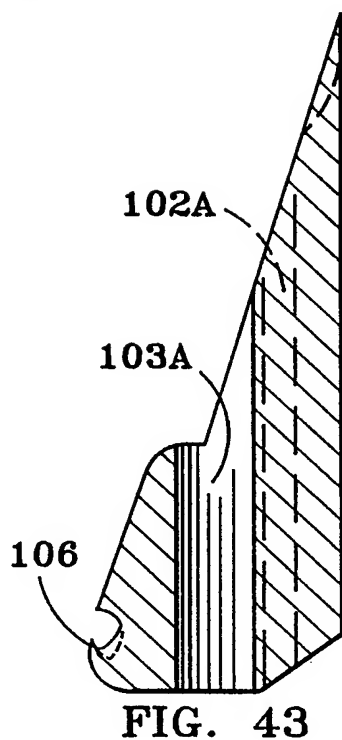


FIG. 43

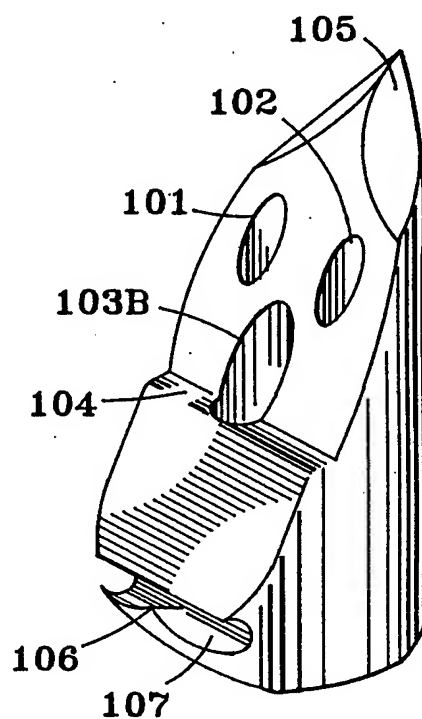


FIG. 45

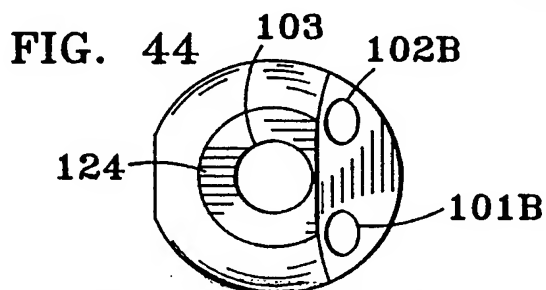


FIG. 44

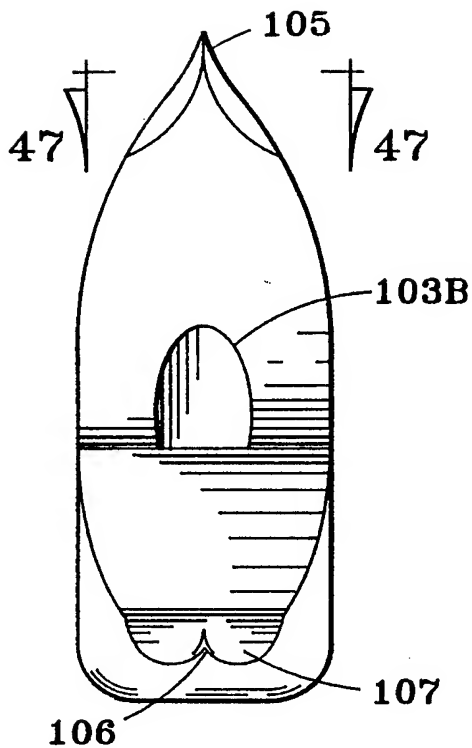


FIG. 46

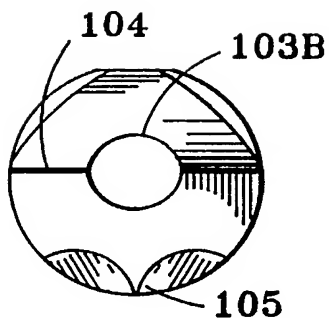


FIG. 47

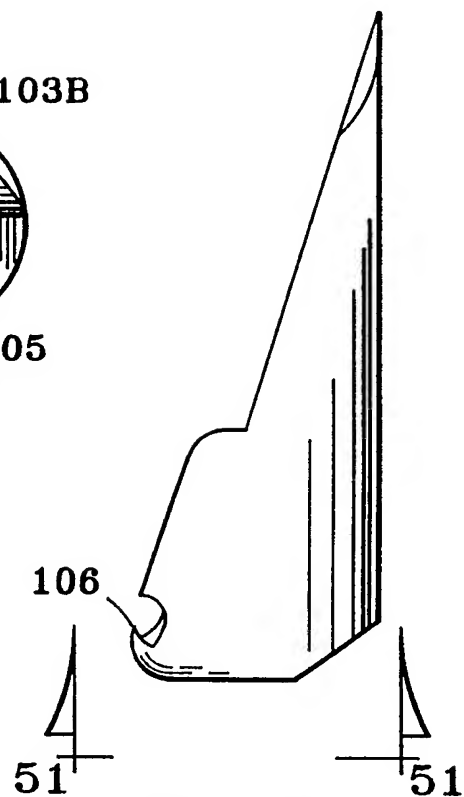


FIG. 48

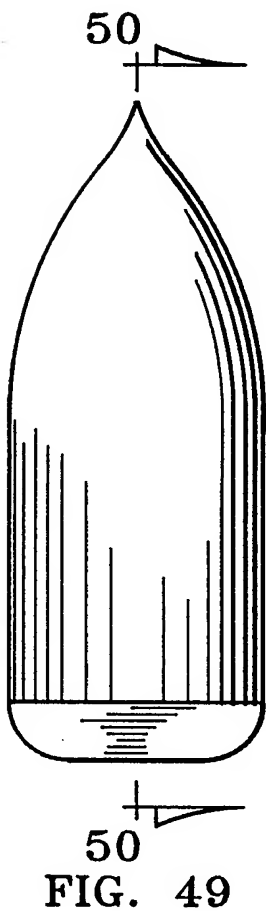


FIG. 49

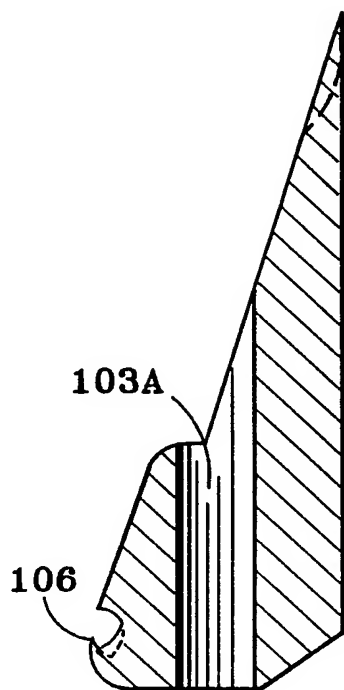


FIG. 50

FIG. 51

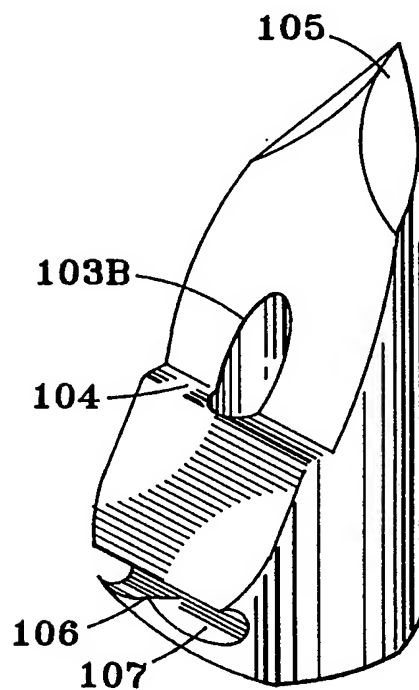
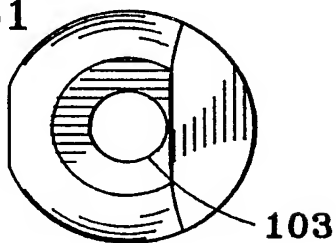


FIG. 52



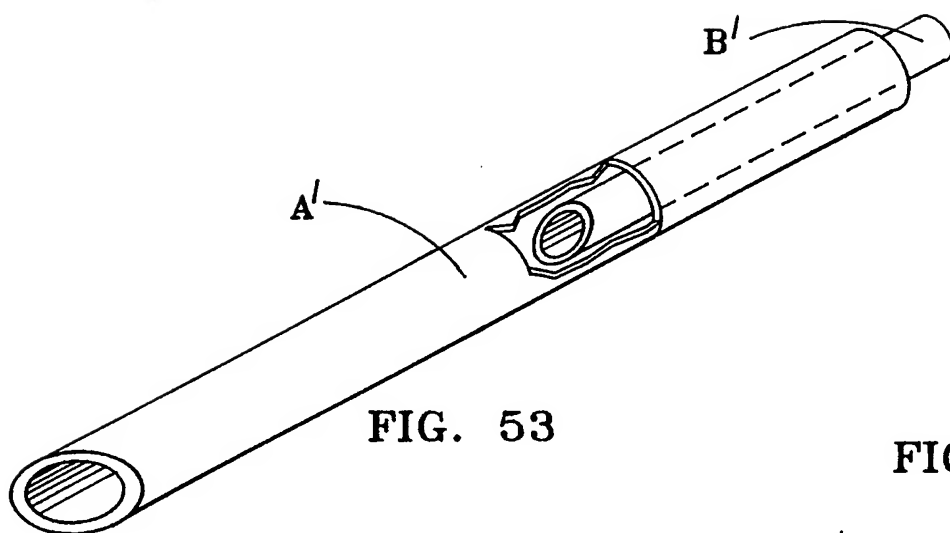


FIG. 53

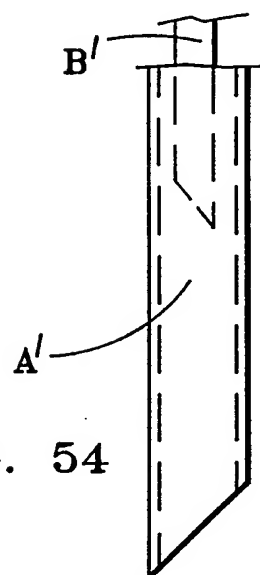


FIG. 54

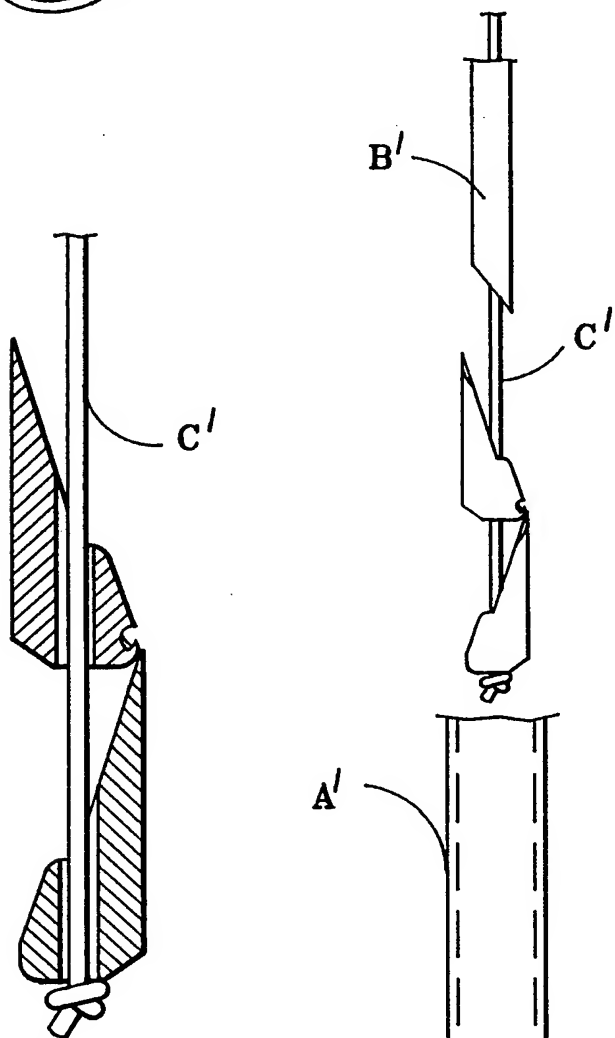


FIG. 55

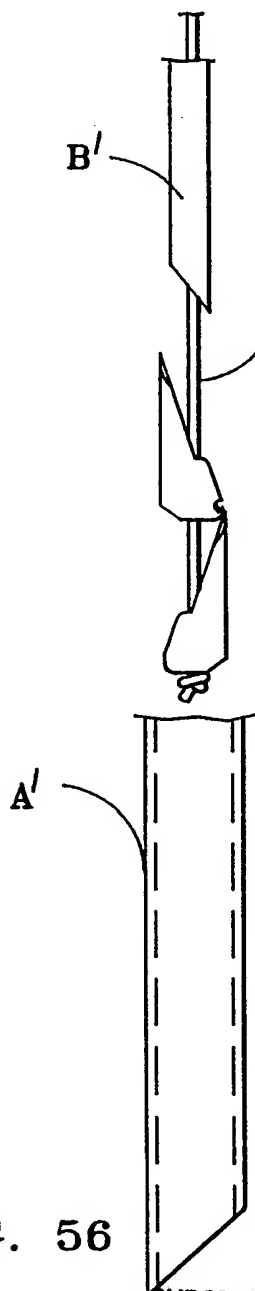


FIG. 56

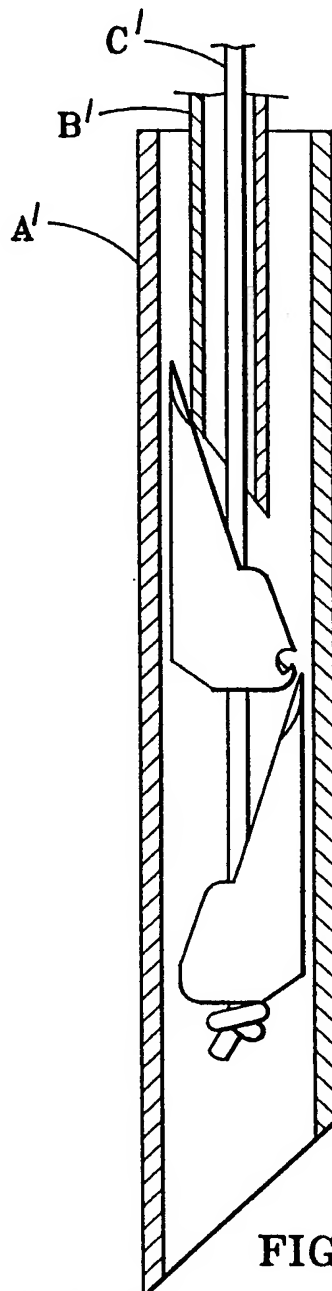
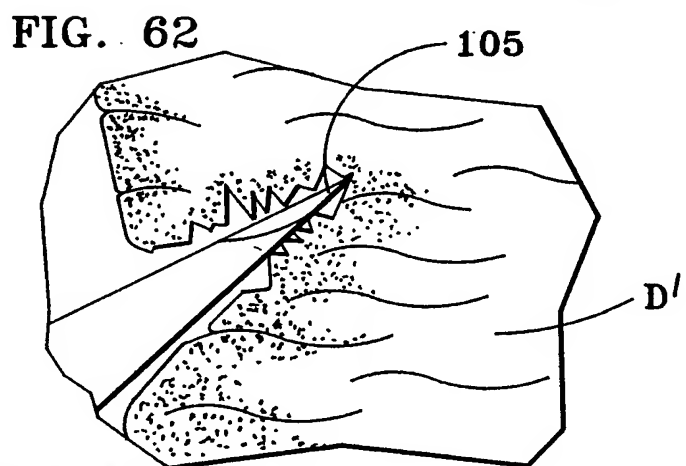
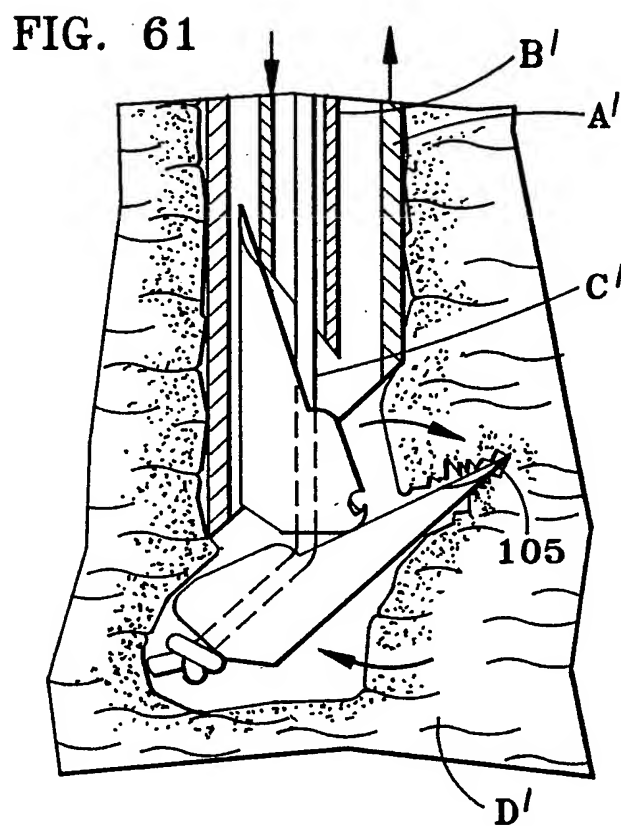
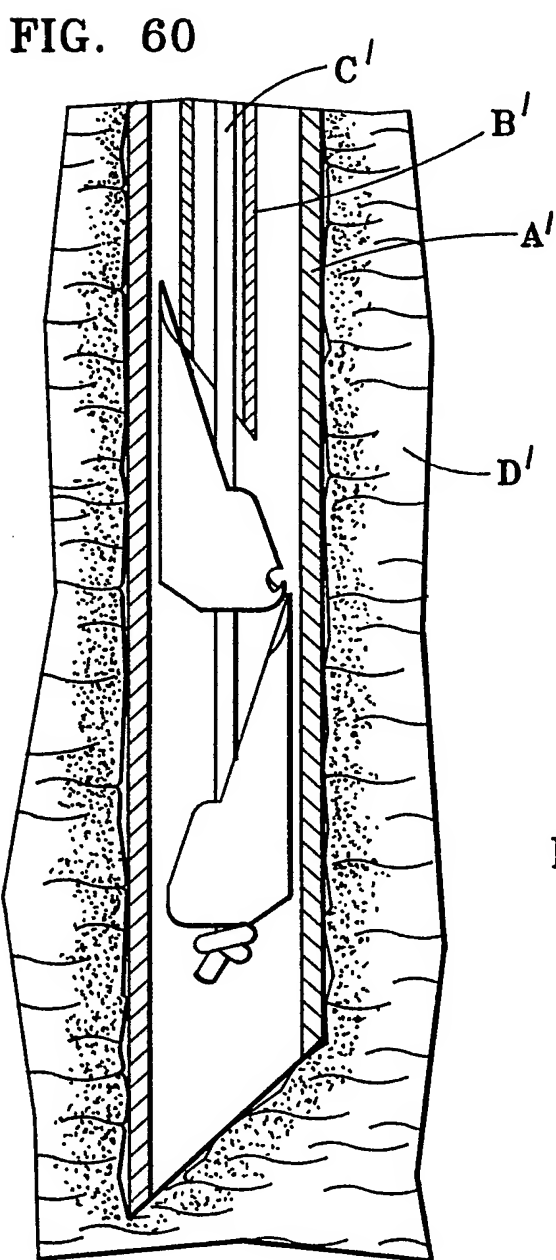
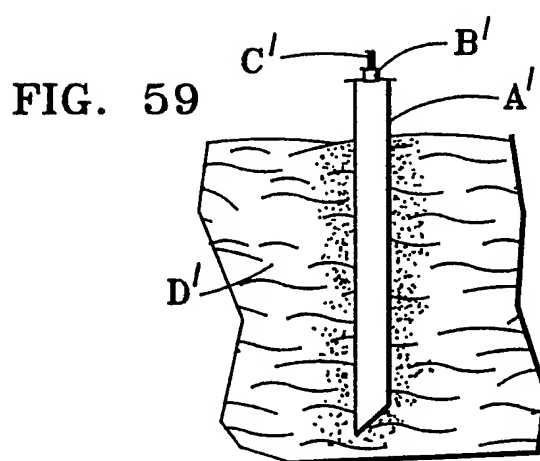
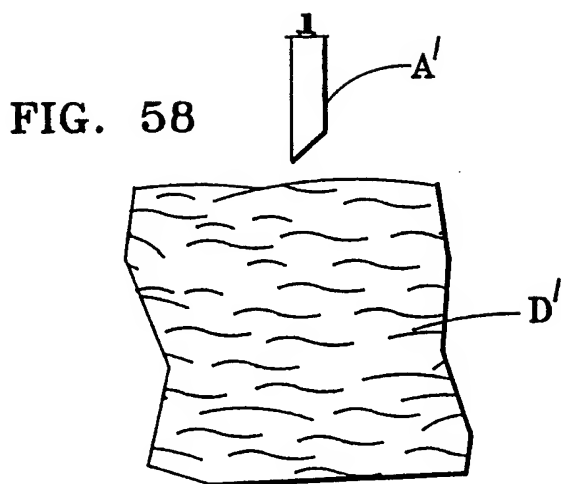


FIG. 57



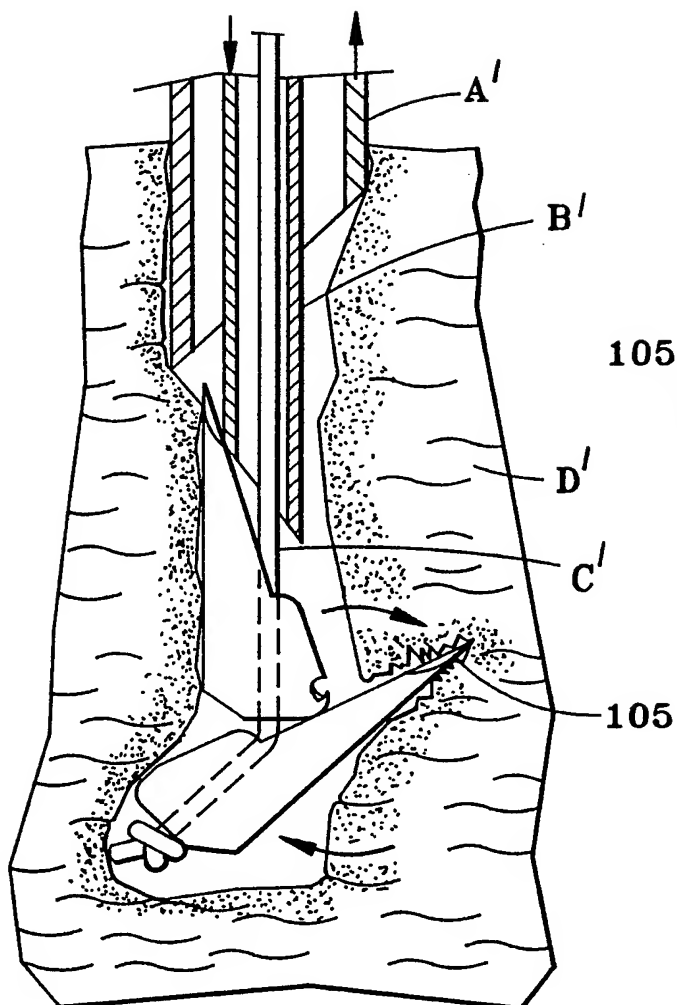


FIG. 63

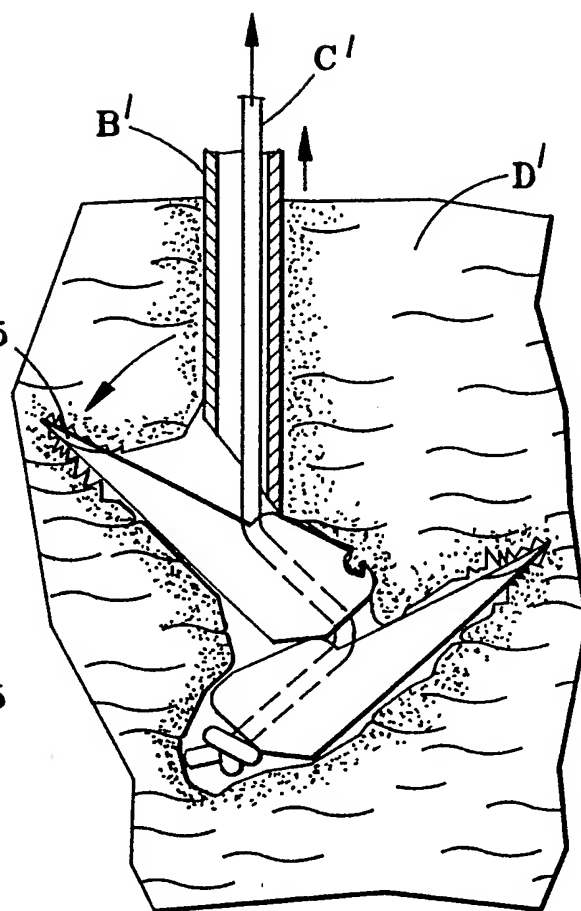


FIG. 64

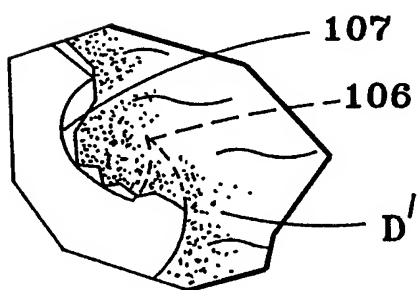


FIG. 65

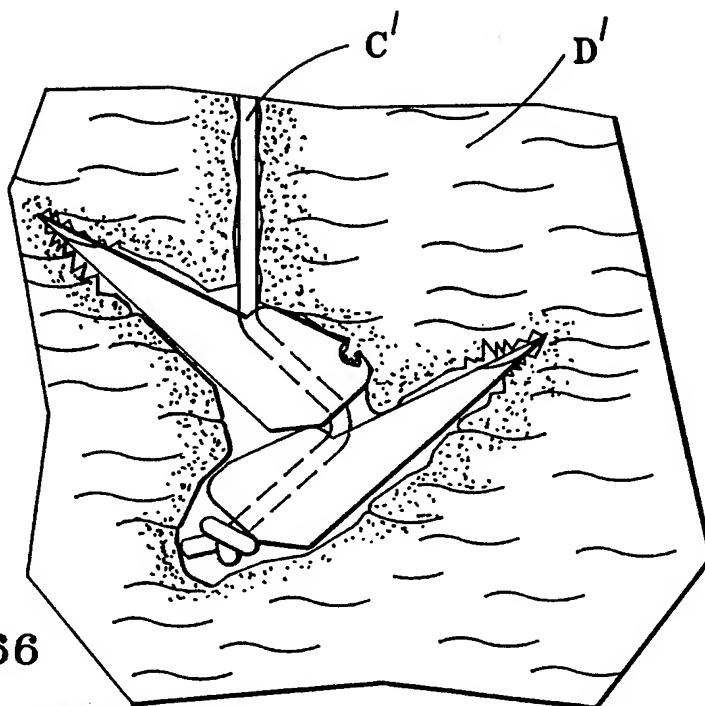


FIG. 66

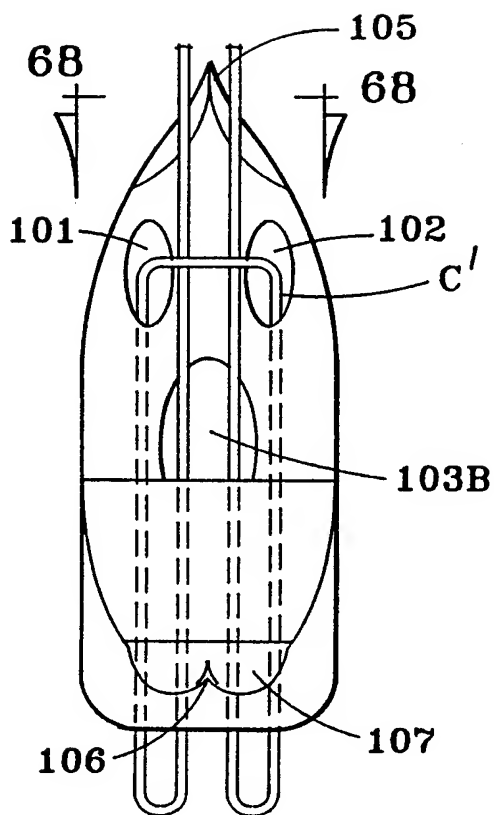


FIG. 67

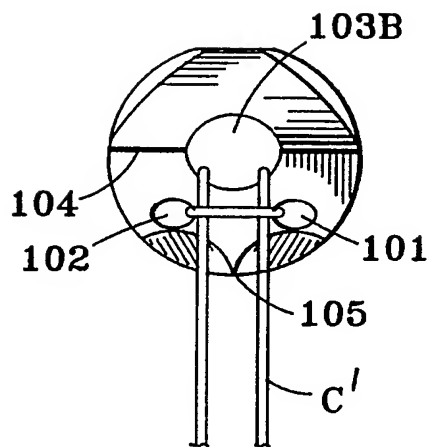


FIG. 68

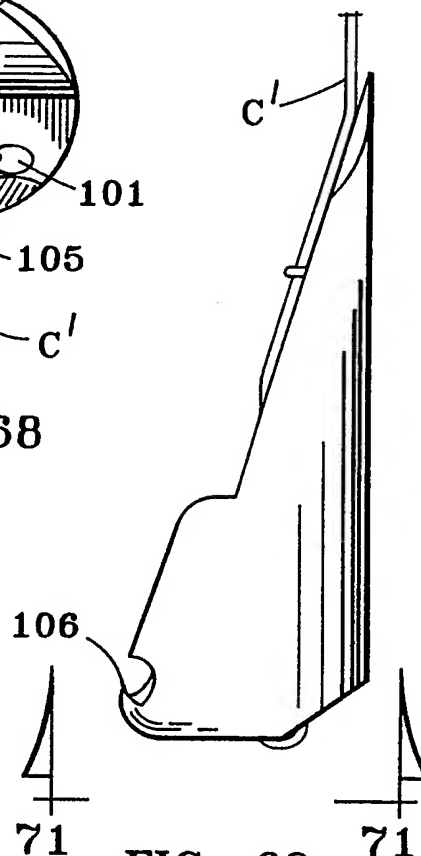


FIG. 69

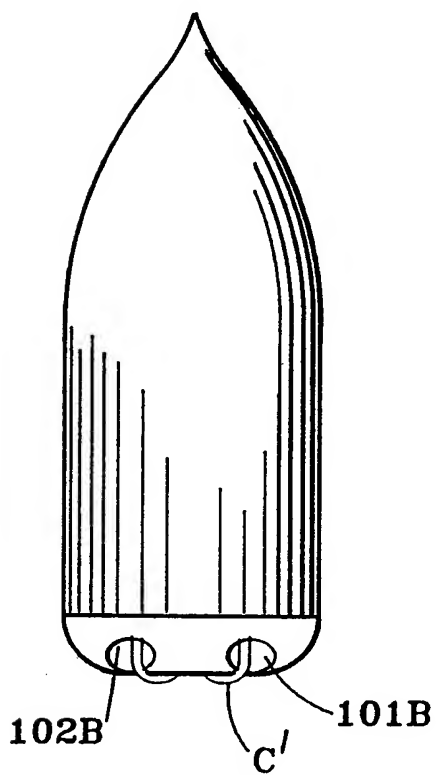


FIG. 70

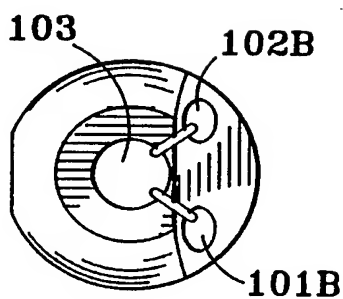


FIG. 71

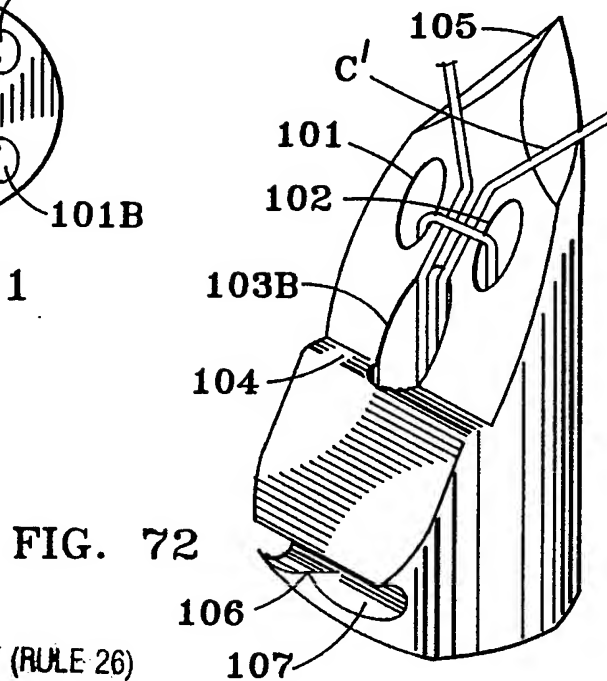


FIG. 72

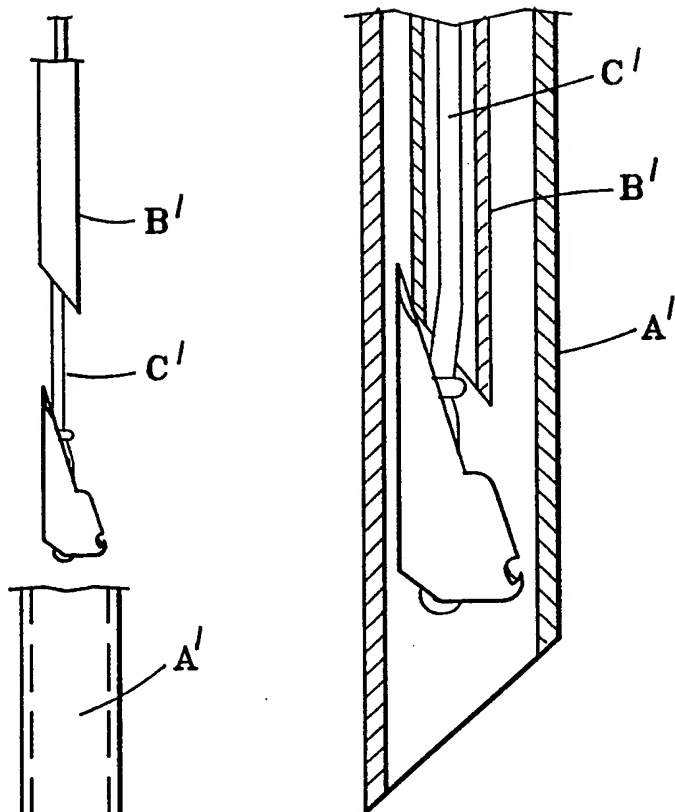


FIG. 74

FIG. 73

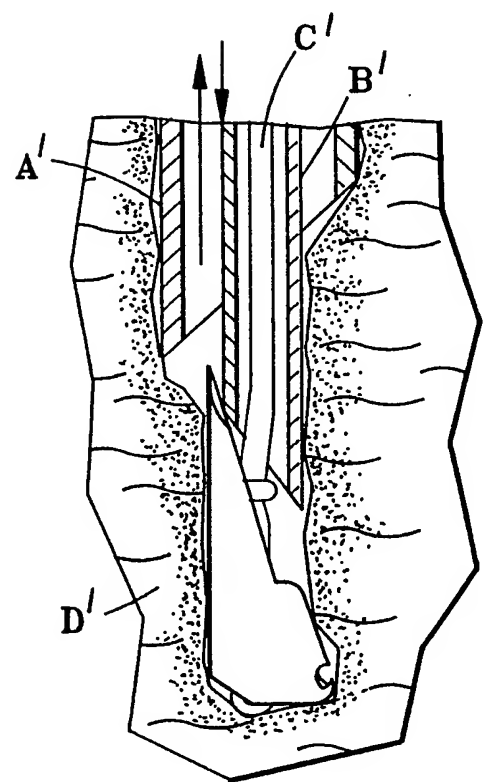


FIG. 75

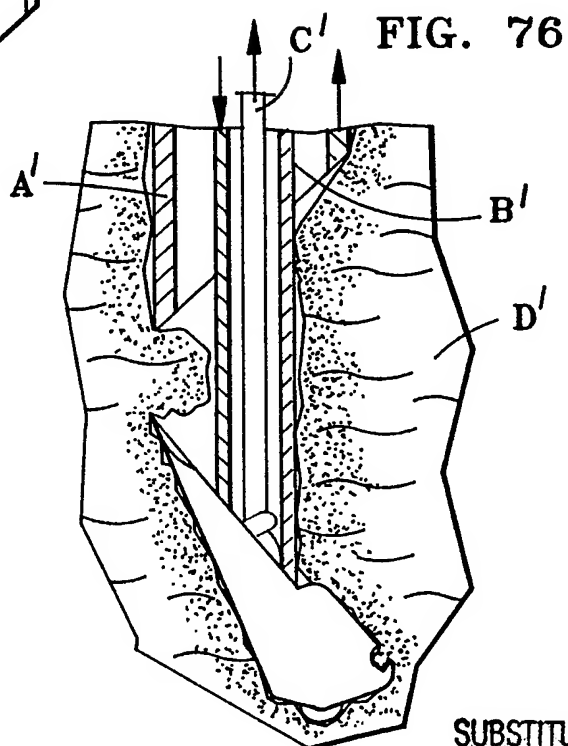


FIG. 76

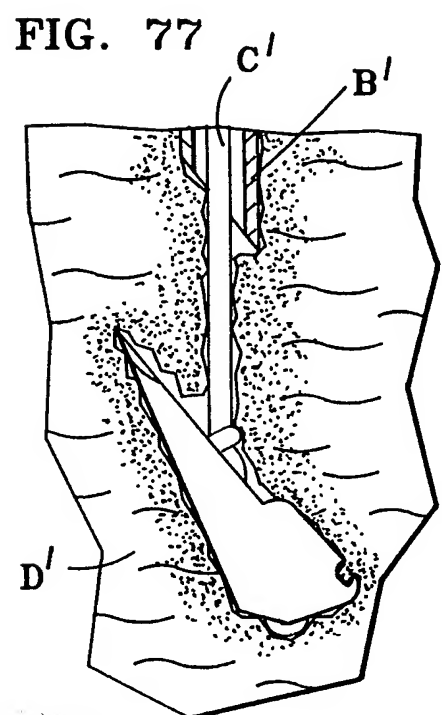


FIG. 77

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US 94/12389A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 A61B17/04

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 6 A61B A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE,U,89 11 360 (MECRON MEDIZINISCHE PRODUKTE) 30 August 1990 see page 4, line 14 - page 6, line 7; figures ---	1,5
A	EP,A,0 317 406 (LABOUREAU) 24 May 1989 see abstract; figures ---	1,3
A	US,A,5 037 422 (HAYHURST) 6 August 1991 see abstract; figures cited in the application ---	1,3,6
A	EP,A,0 464 480 (AMERICAN CYANAMID COMPANY) 8 January 1992 see abstract; figures 1,2,5 ---	8,10,11, 13
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Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

28 February 1995

Date of mailing of the international search report

0 8. 03. 95

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Fax: (+ 31-70) 340-3016

Authorized officer

Klein, C

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US 94/12389

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO,A,87 01270 (ACUFEX MICROSURGICAL) 12 March 1987 see claims 1-3; figures 1,4-6,9 ---	8,10
A	US,A,4 946 468 (LI) 7 August 1990 see claims 1-5; figures 1,2,10-17 ---	8-13
A	US,A,4 898 156 (GATTURNA) 6 February 1990 see figures 1-17 cited in the application ---	8,9,11
A	US,A,5 203 787 (NOBLITT) 20 April 1993 see abstract; figures ---	8,10
P,X	US,A,5 324 308 (PIERCE) 28 June 1994 see the whole document ---	1-7
A	US,A,5 176 682 (CHOW) 5 January 1993 cited in the application -----	

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PCT/US 94/12389

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Information on patent family members

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PCT/US 94/12389

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US-A-5203787	20-04-93	NONE	
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US-A-5324308	28-06-94	NONE	
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US-A-5176682	05-01-93	NONE	
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